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## THE STONE AX IN VERMONT.

### I. CELTS.

BY PROFESSOR GEO. H. PERKINS.

THOSE specimens usually termed stone axes, for whatever purpose designed by their makers, may be grouped under the three heads, celt or ungrooved ax, notched ax and grooved ax. To the first group, the celts, by far the larger number of our ax-like implements, must be referred, and of this alone will the following pages treat, other varieties of the ax being deferred until a second paper. This term celt is convenient rather than accurately descriptive, embracing, as it usually does, a great variety of objects which undoubtedly were put to a variety of uses. We might easily set aside some of our celts as axes, others as chisels and still others as skin-dressers, or adzes, or hoes, but in most cases this definite assignment is wholly theoretical, and hence very possibly erroneous. Moreover, when we attempt to arrange a large series of these implements under the various groups, we soon discover numerous intermediate forms by which all may be united into a nearly unbroken series. There can be no doubt that there were certain uses for which some implements were especially intended, and other uses which others were to serve. Nor can there be any doubt that when occasion required, the same implement served for several sorts of work. For our present purpose it will be most convenient to call all our ungrooved axes celts.

As compared with other classes of implements celts are not uncommon in our Vermont collections, and they exhibit a

remarkable diversity in form, size, material and workmanship. Scarcely any two of them are precisely alike, and among them may be found European forms like some of those figured by Evans, Lubbock, Dawkins and others, as well as forms identical in all essential respects with specimens from various portions of the United States. Any one who studies stone implements from different countries must notice the prevalence of certain common types which are repeated in locality after locality, and in ancient and modern work alike.

Very likely the celt had its origin in the hammer stone. This, at first a well-worn pebble with no wrought surface, was, after a time, rubbed on another bit of stone until at one end a rude edge was obtained. When this was accomplished the hammer had become an ax. The one tool of its kind possessed by early man, it served many purposes, and gradually took upon itself a great variety of forms.

It was a simple and rude beginning, but it was one of the first steps in that far-reaching series by which man has risen from savagery to civilization.

Very rude celts, such as are sometimes found in other localities, are not common in Vermont collections. A pebble merely rubbed at one end until an edge was obtained is not usually the form found; far more commonly the entire surface is hammered, and not seldom smoothed and polished. Some of our best celts are not excelled by our finest specimens of any sort in elegance of form or finish. Almost all the more common kinds of rock found in Vermont appear in the celts, but some kinds are more often found than others, these are trap, greenstone, granite, mica schist and talcose schist; less common are quartzite, porphyry, serpentine, slate, etc. The hollow chisel, or gouge, is connected with the celt by certain peculiar forms which are sharpened like a chisel at one end while the other is hollowed.[1] So too we find gouges in which the hollow is very slight, and in some scarcely noticeable. There is a great diversity in the curvature of the edge of our celts, a perfectly straight edge being never found, and a close approximation to it is not common. In the great majority of our specimens the curvature is considerable, much more than is seen in a modern ax. As the celt is connected with the gouge by certain specimens, so it passes into the regularly

[1] See this journal, Vol. xv, p. 433, Fig. 6.

grooved ax through others. In some specimens there is merely a notch on each side, in others a very slight groove, and so on till we have the typical grooved ax. The form of some of the celts renders the supposition that they were furnished with a handle very improbable, but others undoubtedly were attached, some in one way some in another, to a wooden handle. Whether the prehistoric Vermonter ever adopted the Australian custom of imbedding the blunt end of his ax in a mass of pitch is not to be known, but the material for such a handle was at hand and may have been used.

The average celt of the Champlain valley is about five inches long or a little more, and half as wide. The extremes are found in little hand axes not more than three inches long, and large and sometimes clumsy specimens twelve inches long, and rarely more. In the thickness there is found little relation to other dimensions; some of the longest celts are thinner than many of the shorter ones. In most cases the thickness is greatest near the middle of the length, though sometimes the thickness increases from the edge to the other end. The edge is always carefully worked, however rude the rest of the specimen, and it rarely shows the effects of hard usage. Most of the specimens are hammered over the entire surface, and not seldom they are smoothed and polished, but some are left just as they were cleft from a large mass, and show no sign of the workman except at the edge. In many respects archæological specimens from New England are greatly surpassed by those from the mounds of the West and other localities, but some of our Vermont celts will bear comparison with similar objects from any part of this country or Europe. A very few copper celts have been found in Vermont, but none of any other material except stone, and of these latter only will this article treat.

Without pretending to establish a permanent classification of these objects, but only for present convenience, they will be considered in several groups, which will be determined chiefly by form. Our first group will include such as are linear in outline, the length being several times the width. Some of these are of large size and rude in finish, while others are carefully finished, and in a very few cases there is an attempt at carving in the form of one or more knobs or ridges. Fig. 1 illustrates this variety, and in this as in the other figures, the design is to exhibit an

average specimen of each class. The smallest celt of this class which I have seen is four and a half inches long, but most are much larger. A few of these linear celts are quite thin, in one case the material is common roofing slate of nearly uniform thickness and chisel-like form, and this implement could never have been intended for use as an ax, since the first blow would probably have shattered it. In these celts we find often each of the wide surfaces flat, but in others, and this is the case with a majority of all classes, one surface is flat or nearly so, while the

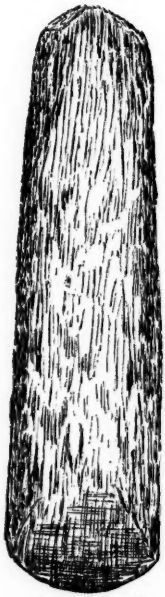

FIG. 1. × ½

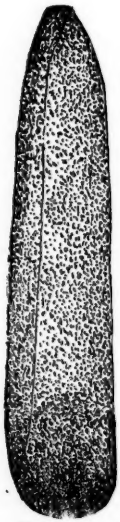

FIG. 2. × ½

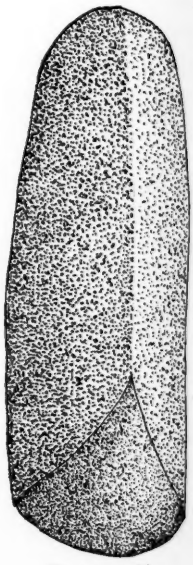

FIG. 3. × ½

other is more or less strongly convex. The flat surface is usually more highly polished than the other.

In Fig. 2 we have a very unique example of the linear celt, both ends being sharpened and one transversely to the other. It is not common to find each end ground to an edge, but I have seen only this specimen in which the line of one edge crossed that of the other. It is a very finely made implement of compact basalt. It was found several feet below the surface in the subsoil, in Weybridge, by Mr. A. J. Stowe. It is nearly six inches long and about one inch in greatest width.

Still another type of celt is shown in Fig. 3, which was found in the same locality. The usually flat surfaces are beveled from a median ridge, as shown in the figure, to the sides. The material is a greenish quartzite and the specimen is very well finished, though not as well as many. It is six and a half inches long, two and a half wide and rather more than one inch in thickness.

The second class of celts are quadrangular in outline. Some of these are large and rude, others small and well made, but as a class they are rude and apparently made for rough work. In some cases, however, they are not strong, but, as in case of the specimen shown in Fig. 4, the material is some sort of slate, and too brittle for other than light work. Much larger specimens of this sort than that shown in Fig. 4, which is only four inches long, occur. One of these is of bluish serpentine, and was polished over the entire surface, although it was not worked smooth, and hence retains the irregularities made by the cleavage. It is nine inches long and more than four wide.

Fig. 4. × ½

On page 433 of Volume xv of this journal, figure 6, is shown a specimen which illustrates the general form of the typical celt of this class, only substituting for the concave end an edge like the upper one in the figure. Very many are ground to an edge at each end, and these are much more carefully made than others which have but one edge.

Fig. 5 shows a type of our third class of celts, those which are quadrangular in outline but narrower at one end than the other, and the narrow end, if there is but one edge, is always that which is blunt. Often in celts of this form each end is brought to an edge, as in the case of Fig. 5, though this is less common than in celts of the second class. These celts are mostly very nicely made and of handsome material, and often beautifully polished. Some of them resemble closely the small celts found in the Swiss lakes. For the most part they are not of large size, averaging, perhaps, three or four inches in length. In none of our stone implements do we find

more beautiful specimens of ancient workmanship than in these celts, some of which, made from a compact, fine-grained serpentine of richly shaded green, are most elegant objects.

There are beds of this handsome material in several localities in the State, and it is remarkable that no objects made from it have been found except some of the celts. Most of the celts of the second and third groups are much wider than thick, but a few are either cylindrical or quadrangular in cross-section. The globular form seen in celts from other localities never appears in Vermont. Our celts appear to have been mainly worked from pieces split from larger masses rather than as in some places from pebbles. A form of celt which may be regarded as a modifica-

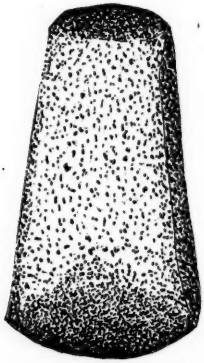

FIG. 5. × ½

FIG. 6. × ½

tion of that shown in Fig. 5 is shown in Fig. 6. This is obviously a hand ax, and although made from porphyry is finely smoothed and polished. Possibly this is one of those specimens of which Lafiteau speaks when he says that they were not finished during a single lifetime, but were handed down as heirlooms to be highly valued. Certainly no short time would be sufficient for the manufacture of so perfect an implement from so hard a stone. This specimen is four and a half inches in length and two and a half in width across the edge. In cross-section it is oval.

Celts of our fourth class are triangular, as is that shown in Fig. 7. Some of these are rude, others finely wrought. The specimen figured is a very beautiful example of this type of celt. It is made of dark brown clay-ironstone marked by a band of

lighter shade. It is very smooth, and the edge is unusually sharp. Both surfaces are quite flat. It is nearly five inches long and three across the edge. Celts of this form are less common than those of the other classes, and are usually of medium size and of hard, compact material, such as quartz, of which several are made, or porphyry. They are almost always made with great care, and even those of granular quartz are polished about the edge and sometimes over the entire surface. As any collector of stone implements will readily believe, there are many celts in our Vermont collections which do not clearly come within any one of the above groups, but are intermediate in their character. Nevertheless there are very few which cannot be placed in one or another of the four classes with sufficient accuracy for a general description. It is rather remarkable that so few of our celts show broken or worn edges. Some of them do indeed bear abundant evidence of severe service, but most have sharp even edges as if only just from the maker's hand. Either the larger part of these implements were skin-dressers, fleshers and the like, as doubtless some of them were, or if used for any work that broke or defaced the edge, they were very promptly repaired, and that this was sometimes done is familiar to every collector. The shape or bevel of the edge is by no means uniform. In some of our specimens the angle inclosing the edge is very large, and the bevel abrupt and short, as in many of our modern tools used by iron workers, while in others it is less abrupt, and in most quite like the edge of our modern ax, for which at best the celt could have been only a very indifferent substitute, although as a flesher or skinning knife or scraper some of the forms may very well have served most excellently.

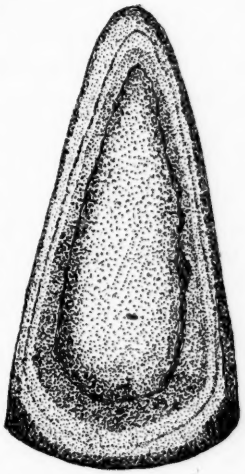

FIG. 7. × ½

# THE RELATIONS OF MIND AND MATTER.

BY CHARLES MORRIS.

*(Continued from p. 1076, November number.)*

## VII. The Physical Basis of Mind.

THAT the mind has a substantial basis does not need an attempt at argument before a scientific audience. The necessity of this is already fully admitted. For those who are not scientists the arguments we have already given must suffice. The claim that the brain is the organ of mind is based almost solely on this necessity. No other substance is perceptible at the apparent seat of thought, and the cerebrum is claimed as this seat in spite of the insuperable difficulties in the way of such a theory.

Yet there is much substance and much in substance which we cannot hope to ever perceive. Our senses are very imperfect instruments, and make us aware of but a minor portion of what exists. Our most important sense, that of sight, is blind to the great realm of gaseous matter. The microscope reveals to us worlds of existence which the unassisted senses could never have discovered. By the aid of delicate tests and instruments many of the less gross and active conditions of matter have been made apparent. In this way the range of our sensibility has been very greatly increased. And yet we are but on the threshold of the universe. Important conditions exist to which the senses of man have never responded. Important conditions exist to which our physical senses can never respond. We have the strongest reason to believe in the existence of substance all around us of which we can never become sensible.

Some review of the conditions under which substance appears to exist becomes here requisite. In the science of a century past matter was but one of several distinct forms of substance. It was accompanied by a number of *ethers*, or imponderable essences, one each for heat, electricity, magnetism, &c. Indeed, the facility with which a new ether could be constructed to meet every new phenomenon of energy threatened in time to produce a condition as cumbrous as the old epicycle theory of astronomy. That was set aside by the discovery that the earth was a moving instead of a resting body, and the ethers similarly vanished when it was discovered that motion was the distinguishing feature in them all. From this readiness to manufacture ethers the pendu-

lum of belief swung to its opposite side, and a general incredulity on the whole subject of ethers succeeded. In more recent times this incredulity is giving way, and our most skillful physicists are fully persuaded of the existence of one ether, the medium of light radiations. To those scientists the universe contains two distinct substances, matter and ether, which differ radically in their conditions of existence.

Students of the phenomena of light declare that there is no possible escape from this conclusion. Interstellar space is probably occupied by ordinary matter in a state of extreme diffusion, and it might be conjectured that the rays of light could make their way through this substance from star to star. Science declares that this is impossible. Matter, under such circumstances, must be a very rare gas, and no gas can transmit transverse vibrations like those of light. Its degree of diffusion also would be far too great and too irregular. To transmit the rays of light some substance is needed that is very elastic; that, while exceedingly rare, is far more dense than diffused matter would be in interstellar space; and that is in the condition of a rigid solid instead of a free gas. Yet it must be a solid so readily permeable as to present no resistance whatever to the movement of the spheres. As a ball will sink with little resistance through a thin jelly, without leaving a mark of its passage, so must a globe be able to plunge unopposed through the almost infinitely thin jelly of the ether.

Ether has never been seen, felt, weighed or measured. It is absolutely invisible and intangible. No vessel has pores so minute as to confine it. It has properties seemingly contradictory; it must be excessively rare yet perfectly elastic; its physical state must resemble that of the solid while its density is immensely less. We have no proof of its existence resembling our proofs of the existence of matter, yet we are forced to believe in it because physical science cannot possibly do without it. There are hundreds of phenomena which cannot be explained without it, but can readily be explained with it.

Sir William Thomson, in his lecture before the Franklin Institute during the 1884 meeting of the American Association for the Advancement of Science, said of this intangible necessity: "You may regard the existence of a luminiferous ether as a reality of science." "One thing we are sure of, and that is the

reality and substantiality of the luminiferous ether." And he proceeds to say that it is the only thing we are confident of in dynamics. This ether he describes as an elastic solid, its rigidity enormous in proportion to its density. As to whether it possesses weight or not he declares that there is no evidence for or against.

J. Clerk Maxwell speaks as strongly on the subject, and finds a new use for the ether, as the medium of electric and magnetic energy. He advances a theory, which has met with much favor, that "light is an electro-magnetic phenomenon." In other words, both these modes of traveling energy employ the same medium and are carried by it with a rapidity extraordinarily greater than any known movements of vibrations in matter, such as the waves of sound. Ether, therefore, is supposed to permeate all substances, however dense. It conveys electricity through the densest solids, and light through the densest transparents. We can reduce air, by the air pump, to one hundred thousandth of its volume, and yet it is firmly held in a glass vessel. But light passes through the vessel, and through its partial vacuum, without a check. The substance which carries it moves as freely as if no other substance was present.

There is, however, a seeming relation between matter and ether, if we accept the latest atomic theory, that of vortex motion, propounded by Sir William Thomson. It is not necessary here to explain this theory; it will suffice to say that it holds that fragments of the ether possess a vortical motion by which they become separate and indestructible integers. Each such vortex atom must have always existed and must always exist. They are indestructible and unchangeable. No new ones can arise, and no old ones can vanish. They must be coëternal with ether. Their substance is the same as the ether itself. They are simply portions of ether affected with a certain mode of motion. But as thus constituted they are essentially distinct from ether, and the two constitute two unlike conditions of substance. This conclusion is probably true whatever the character of atoms, and whether the vortex atom theory be correct or not.

Professor Oliver Lodge gives the following particulars concerning this substance.[1] The density of ether, though small, is

[1] The Ether and its Functions, *Nature*, Jan. 25, 1883.

enormously greater than that of the earth's atmosphere can be if the atmosphere extends indefinitely into space, as is highly probable. The rigidity of ether is insignificant as compared with ordinary solids, yet its transmitting power is enormously greater than that of steel or glass, on account of its very slight density. The ether within glass transmits vibrations 40,000 times as rapidly as the particles of glass itself could do. But the atmospheric ether carries these vibrations at a speed one-half greater. The speed, therefore, is checked within glass to two-thirds its normal amount. Why is this? Is ether affected by gross matter, and concentrated by attraction so as to increase its density? Fresnel's hypothesis is, that the ether is really denser inside gross matter. He thinks that an attraction exists between ether and the molecules of matter which results in an agglomeration or binding of some ether round each atom, and that this bound ether belongs to the matter and travels with it. The free ether may flow without check through the pores of matter, and even through those of the earth as it dashes onward through space. Refraction of light from such a cause is attributed to bound ether, which seems to act differently on the different colors.

Certain experiments have been tried to prove whether any of the ether can be bound. If ether is carried along with a moving stream, as of water, it should hasten the speed of light passing through that stream. If not carried by the stream there could be no effect on the speed of light. The results of these experiments have been favorable to the hypothesis. Yet the variation in the speed of light from such a cause is so slight that it is difficult to reach any very positive conclusions on this subject.

That ether possesses energy is unquestionable. It moves with such extreme readiness that it cannot fail to possess a large sum of normal motions. Its physical condition also is indicative of conditions of energy. Elasticity, rigidity, solidity are due in matter to the interactions of attraction and motion, and we have no warrant to ascribe them to any other cause in ether. But the motions normal to ether are certainly very different from those normal to matter, since ether refuses to accept the motions communicated to it by matter. This is what we must understand from radiant light and heat. Matter forces its motions upon ether, but the latter substance refuses to absorb them, and merely transfers them, with the utmost rapidity, to some distant mass of

matter. We know that the sun exists because its energy is transmitted to the earth by the ether, and acts upon the matter of the earth. Were not the ether a perfect transparent to this material energy we could never become aware of the existence of sun and stars, since their light and heat-rays would be swallowed up long before they could reach us.

Ether is, in fact, the most homogeneous body in the universe. It is in a state of motor equilibrium, its motions probably being exceedingly more rapid than those of ordinary matter. It has no direct motor relations with matter, but transmits to distant matter all motion forced upon it, by aid of the vibrations of its particles or separate portions, which are localized in position, like those of the solid. J. Clerk Maxwell speaks of it as follows: "Whether this vast homogeneous mass of isotropic matter is fitted not only to be a medium of physical interaction between distant bodies, and to fulfill other physical functions of which, perhaps, we have as yet no conception, but also, as the authors of the *Unseen Universe* seem to suggest, to constitute the material organism of beings exercising functions of life and mind as high as or higher than ours at present, is a question far transcending the limits of physical speculation."[1]

Not having read the Unseen Universe, I am unaware of the precise character of its speculations, yet I cannot imagine the luminiferous ether as possessed of such powers. For life and mind organization seems necessary, and organized ether is distinct from free ether, and must be some condition analogous to matter, which is probably one form of organized ether. Bound ether, or atom atmosphere, may represent such a second state of organized ether. For all we know to the contrary a second series of atoms may be formed by this condensing action of matter on ether, atoms intimately connected with matter and assimilated with it in motion, yet differing in density of substance and motor rapidity. It may be possible that several series of such atoms exist between matter and ether, each capable of forming a basis of life and mind. Whether originating independently, or each rarer series formed by the condensing action of a denser series, the energies emitted by the atoms of one series could not act on those of another series. Free ether would serve as a medium for the vibrations of them all, but the vibrations yielded by each would pass unresisted through the substance of every other series,

[1] Article "Ether," Encyclopædia Britannica.

and only be absorbed by substance of the same series. The range of material vibrations seems to be from about a hundred million million, or perhaps lower, to sixteen hundred million million pulsations per second. The slowest vibration emitted by an atom of rarer constitution might lie above this speed, and range upward from this point of rapidity.[1]

It is with the bound ether that we are here concerned, that which, in the opinion of many able scientists, surrounds material atoms and molecules like an atmosphere. The existence of such an ethereal atmosphere carries with it the implication of some conformity in motion between the atom and its atmosphere on the same general principle that operates in the case of the earth's atmosphere. And the condensing relation between the atom and its atmosphere can hardly be any other than that of attraction. Yet it does not necessarily follow that the motions of the bound ether must be in every respect identical with those of the atom it surrounds. A motor leverage doubtless exists between them, but leverage of a different character may act on this bound ether from without. It may possess special motor conditions of its own, as the terrestrial atmosphere while possessing the general motions of the earth has special motions which are not shared by the solid matter of the earth's mass.

These conclusions seem almost necessary deductions from the widely accepted view, above given, of the relations of matter and ether. There is another conclusion, at which we have already hinted, not a necessary yet a conceivable consequence. This is, that bound ether may, under certain favoring conditions, attain an organized state not dependent upon that of matter, and be capable of permanently retaining this condition. If, as is probable, molecules composed of many atoms possess an ethereal atmosphere, then the disruption of the molecule need not necessarily disrupt its associated ether. Though ether is organizable under the influence of matter, yet the forces which disrupt gross matter might, in certain cases, become powerless upon ether. If so, a mass of ether which had been organized by the influence of a mass of matter might retain that organization unimpaired after

[1] For an able and elaborate treatment of this subject see Professor A. S. Herschel's letters in *Nature*, Vol. 27, pp. 458, 504, and Vol. 28, p. 294. These were written in answers to articles by the writer on "The Matter of Space," and constitute an important treatise on the constitution of the ether, its relations to matter, and its possible atomic variations.

the material mass had become disintegrated, and might continue to exist as a molecule or mass of a constitution much more rare than that of matter.

Possibly this power of becoming independent does not exist in the case of atomic or molecular atmospheres of bound ether. But it may do so in the case of the bound ether of more developed compounds. We may look upon the crystal, the plant, the animal, even on the body of man as possessing, in addition to the free ether that readily permeates them, a mass of condensed or bound ether which reproduces every detail of their organization and every specialty of their motion, from that of each atom to that of the organism as a whole. In such a case the cerebrum might possess such an ethereal atmosphere, not only reproducing it in organization, but affected in its motor relations by every impulse received from without which is not consumed as muscular motion. There are certain good reasons for believing that such a psychic substance exists, intermediate in condition between matter and ether, and sending out vibratory energy like that of matter. This psychic substance yields no energies which can affect matter at a distance, and it is not affected by the emitted energies of distant matter. It can affect matter and be affected by it only while an intimate connection exists, like that between the cerebrum and its psychic atmosphere, and only through the agency of this connection. In this relation the psychic substance assumes the general motor conditions of the cerebrum, with which it is so intimately associated, and is also sensitive to special motor conditions coming from distant matter. It is, therefore, organized by the conditions of energy in the material universe. It, in addition, gains special motions through its own interactions, and impresses these upon the universe. As compared with matter its substance is excessively rare and its motions excessively rapid. Its mobility is therefore extreme, and its susceptibility to new influences far beyond anything existing in matter. Finally it may be capable of retaining its organization separate from matter, its constitution being such that the disrupting energies which destroy the organization of matter are powerless to affect the psychic organism, they being repelled from its surface, or passing through it as innocuous vibrations. Under some such conditions, and such only, can we comprehend the existence of a physical basis of mind. And thus only can we conceive the

possibility of the existence of the mind after the disruption of the body, in substance absolutely imperceptible to our senses, yet forming organisms which may be as evident and substantial to each other as are our material bodies to each other.

So far all this is pure hypothesis. We have only offered as evidence for the existence of a psychic substance the seeming incapability of the brain to serve as a mental basis. Yet other evidence exists of considerable force and value. We know that a psychic substance must exist for the same reasons that we know an ether exists. We cannot see, touch or weigh either, but there are phenomena in nature which we cannot possibly comprehend without them. We believe in the ether because there are things done in the universe which matter could not possibly do. We may find ourselves forced to believe in a psychic substance for reasons of the same kind.

If masses of matter send out radiations of light and heat which affect distant masses of matter, then psychic masses, when actively excited, should send out parallel radiations which will affect other psychic masses, but fail to act upon matter. Evidence of the existence of such a condition is by no means rare. Every mind seems to send out psychic radiations which flow like light rays through ether in every direction, weakening with distance. At least by such a hypothesis we can understand some very remarkable mental phenomena which now stand as incomprehensible mysteries. These we can but briefly glance at. One very common instance of this, which has occurred to most people, is the tendency to think and speak of a person immediately before he appears. Some indication of his coming seems to be in the air, but as an influence that acts not on the senses but directly on the mind. In certain instances persons declare that they can see a mental image of every approaching friend. If our hypothesis be true, it must be that every mind sends out radiations peculiar to itself, as every physical object does, that this peculiarity is recognized by the receptive mind, and consciousness directed thereby to the mental image of the person to whom the emissive mind belongs, precisely as it would if we saw some physical object belonging to that person.

When the emissive mind is actively exercised and is strongly thinking of the receptive person, this influence may be carried to much greater distances, and may rouse the consciousness of the

person thought of at thousands of miles away. We shall give, further on, an instance of this kind. The psychic rays may be viewed as preserving the record of their source at any distance, as in the star beams we can read the story of the physical constitution of the star, however enormously distant.

Another less common phase of this action is the tendency for two persons to speak simultaneously of the same thing. This is of various strength in various cases. One lady tells me that she formerly had a girl for companion in whose presence she did not dare to think of anything she wished kept secret, for the girl was exceedingly apt to speak of anything the instant she had thought of it. The power to make a person turn by fixing a steady gaze upon him is of this same general character. Numerous instances of these more ordinary phases of psychic intercommunication might be adduced, but we shall here mention them only in this brief manner.

One thing is evident, even in these phases of the subject, that there are great differences between the emissive and receptive power of different persons. This becomes much more marked in special cases of psychic influence. It may be to some extent, a question of transparency and opacity. We know what very great differences exist in the conductive powers of different substances for electricity. Psychic radiations may find like variations in the physical conditions of different individuals. From one mind they may flow out as through a transparent. In others they may be more or less resisted by the matter of the body. In some cases the resistance may be complete. Reception may present the same variations, a sensitive or medium being one who is unusually receptive of these vibrations. Such an idea would explain the vigorous mesmeric controlling power of some minds and the ready yielding to mesmeric control of others. And on the principle that nerve currents flow most easily along a familiar channel, we may understand the special rapport between certain operators and sensitives. In this case the body substance of the sensitive has grown specially transparent to the psychic emanations of the operator, while it may be more or less opaque to the emanations of other minds.

As to the evidence of a more decided character than that above given of psychic intercommunication, a vast volume of incidents might be offered. But the great sum of these lack the

essential element of scientific precision of investigation. It will be best, therefore, to confine ourselves to the results attained by the London Society of Psychic Research, since the experiments of this society have been conducted under strict test conditions, and the reputation of its members as working scientists gives a weight of credibility to their testimony. After the elimination of every imaginable source of error, results were attained which seem to prove incontestibly the direct intercommunication of mind with mind. These results are given in full detail in the published Proceedings of the society, but can be only briefly glanced at here. They consist of what is called thought transfer, mesmeric experiments, phenomena of apparitions and other strange conditions of mental manifestation.

In the thought transfer experiments we have striking evidence of the action of mind on mind without the aid of the senses. In these experiments objects, numbers, &c., were named, and drawings reproduced with no other guide than the mental concentration of the persons who alone knew the character of the object or drawing. The successful results formed so large a percentage of the whole as to leave chance quite out of the category. There seemed no room for doubt that the thought in the mind of the impressing persons had directly acted on the mind of the sensitive, without possible sensory connection. In explanation of these and other phenomena, Messrs. Gurney and Meyers offer a theory of telepathy, or direct communication of mind with mind without sensory aid. But their theory is imperfect in that it lacks the conception of any physical medium of intercommunication as here advocated.

(*To be continued.*)

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## FLOODS, THEIR HISTORY AND RELATIONS.

BY WILLIAM HOSEA BALLOU.

FLOODS vary in their intensity and duration according to their geographical range. There are two great flood ranges in the United States lying nearly at right angles, one of duration and the other of intensity. The first is the Mississippi river and its confluents, and the second the Ohio and tributaries.

The Mississippi and Missouri rivers lie in a north and south line, and their floods are continuous from early spring until the middle of July, on account of the slow advance of the sun's heat

into the northern mountain and lake sources. While the floods thus formed are never of great height comparatively, yet their long continuation and force are means of most potent destruction.

The Ohio flood range is the most terrible on the earth's surface. The water waves generated by it surpass in height, size and power the greatest tidal waves of the ocean. All atmospheric destruction by tornado, simoon, whirlwind and waterspout, and all the damage done through subterranean upheavals by volcano and earthquake do not compare with the ravages of the floods of this river. Here is a stream lying nearly parallel with the equator, every portion of which is simultaneously affected by the sun's heat. When the temperate zone is turned toward the sun in the spring, the Ohio's ice, its entire drainage area and all its sources are let loose at once, and a sudden and awful destruction follows. At this time the Ohio is not a tributary of the Mississippi; the latter is its confluent. Its gigantic projectile of water, often 100 feet high, 600 feet broad and 300 miles long, is hurled on its mission of obliteration, sweeping before it cities, towns, forests, farms, levees, live stock, shipping and humanity. When it reaches Cairo it is re-enforced by the gradually forming floods of the Mississippi and Missouri, and there begins its unlocking of gigantic ice gorges which greatly increase its destructiveness. To protect the riparian country from these floods and repair their damages, the United States has expended $500,000,000. The individual losses sustained probably amount to twice that sum.

There is an intimate connection between floods and business. High floods and low business go hand in hand. The present financial depression was directly precipitated and perhaps caused solely by the last great flood at Cincinnati. That city was then—as in every spring time—largely in debt to New York, Chicago and other commercial centers, for merchandise. Owing to the condition of the roads and the losses of small riparian and dependent towns and cities from the flood, the Southern merchants could not collect on the products supplied by the North. They were therefore obliged to renew their notes. Then mercantile failures in the South precipitated a total loss on these notes, and the bankrupt era began to spread over the country. A large area of the South soon ceased to become a market for the North, cut-

ting off a part of the business of the latter and projecting a general stagnation. Capital, which otherwise would have gone South (which at that time was almost the sole region of investment) to aid in its development, was locked up in safe-deposit vaults and Government bonds, causing a bank scare and many bank failures. The depression soon spread to England and other countries. A retrospective glance into American history shows that great Ohio floods and great financial crises have gone hand in hand.

It is evident that having spent an entire century in trying, with no lasting effect, to repair damages done by floods, the country should turn its attention exclusively to their prevention. The methods of prevention are simple but expensive. Numerous reservoirs should be constructed among the springs in the hills, and little lakes in which to lock up the water. Great forests should be planted about the sources of the Ohio which will hold snow and ice unmelted for a long period, and allow it to escape slowly. In this way the sun will be made powerless to unloose the entire Ohio flood range at once, and the waters held subject to national control.

Congress has considered the question in its usual manner. It overlooked the facts presented above, and empowered the Engineer department to make surveys at the headwaters of the Mississippi for reservoirs. It might as well have gone to the headwaters of the Ganges, which have about as much to do with the destructive elements of these floods. It dropped $60,000 into this project and then dropped the subject. The future battle is the Ohio, not in Northern Minnesota or the moon. Congress will find it cheaper to purchase the land sources of the Ohio and its confluents, plant them with forests and wall them, than to plaster broken levees.

Professor Swing, of Chicago, has suggested that the high mounds of the mound-builders were used as protection against cyclones. He was obviously mistaken. There are no high mounds in cyclonic areas. We find them exclusively in riparian connection, where they were evidently intended for use in time of floods. These mounds were nowhere used to dwell in. None are found with entrances or hollowed out. When opened they either contain skeletons, implements, relics, pottery or nothing at all. Those unoccupied show that the owner fled or was captured

or was slain before his natural death, so that he could not be buried in his own tomb. The high mounds in the valleys served both to protect the dead from floods and as watch-towers in time of danger.

One of the remarkable aspects of floods is their influence on the formation of valleys. Nowhere is this more clearly shown than in the valley of the Mississippi below Cairo, over which the floods distribute themselves to a width exceeding forty miles in many places. This valley has a bed of alluvial silt deposited in past flood times increasing from forty feet at Omaha and Dubuque to 300 feet at and below New Orleans. In other words, the flood alluvial deposit of the Mississippi covers 80,000 square miles to an average depth of 170 feet, a surface equal to Montana. In this elastic valley the floods annually work out the destiny of the river's bed, which is often found miles from its previous course after high water.

The ice-gorges which dam up the rivers and hold back the waters for hundreds of miles are another destructive factor of floods. When they break the resulting destruction is enormous. Congress has only to supply its existing snag-boats with dynamite in order to destroy these before the damage force is accumulated. The Government signal service along the rivers can give warning of their formation.

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## THE PROBLEM OF THE SOARING BIRD.

BY I. LANCASTER.

*(Continued from p. 1058, November number.)*

AS soaring is a phenomenon dependent entirely on bird and air, which are not connected with the earth, to avoid confusion it is best to pay no attention to the latter. For instance, a bird motionless in regard to a point on the earth facing a five-mile-per-hour breeze; the same bird moving in calm air at the rate of five miles per hour, or going with the wind at the rate of ten miles per hour, are identical in character so far as soaring is concerned. In each case the wind is meeting the bird at the rate of five miles per hour, and the differences of translation over the earth are accidental, not concerned with the mechanical activities of flight.

A bird resting in a minimum breeze cannot fall to the rear without descending; neither can it rise vertically nor at any angle obliquely to the rear. It can draw forward on the air at any speed, and when the minimum is exceeded, can then fall to the rear, or rise until the minimum is once more reached. At the minimum velocity the bird's wings are stretched to their extreme limit and the angle of inclination is the greatest. As the breeze stiffens, the bird, if it remains in the same place, flexes its pinions and reduces its incline. The frigate bird will float in a storm with not more than one-quarter of its wing surfaces exposed. Sometimes it bends the points of its wings downwards until they meet underneath.

The positions of the stretched wings in regard to a level with the body of the bird also varies. Those of the frigate bird will average level, the buzzards will be above and the gannets below a level.

For at least three hundred days in the year these birds could be observed in the air, and when the attention was given to their actions for a considerable time, at all seasons, and in the various situations found on so varied a coast as that between Tampa bay and the Capes of Florida, not only the habitual methods common to ordinary soaring flight, but the unusual ones, incidentally performed to meet some emergency, were witnessed. The birds also have periodic seasons of feeling which puts them on behavior that in a man would be thought idiotic. The months of February and March, the time of breeding, are prolific in these singular air-tumbling performances. They served to emphasize the complete difference between active and fixed wing flight.

Being informed by parties from Charlotte's harbor that sandhill cranes could be found there, I sat out in search of them. An outside passage of thirty miles was required, which was safely made, and at nightfall I was among the Gasparilla keys. The wind being favorable and the weather fair, I kept on the outer beach, and at length drifted through a pass with the swiftly running tide in company with innumerable sharks, porpoises and fish, great and small, all headed for the bay. Rounding the point I threw over the anchor, and enveloped in a blanket with face towards the stars, slept, as one who manages a small boat for twenty hours can sleep. About daylight I was awakened by the thumping of the mast against the limb of a stunted cedar tree obliquely

jutting from the bank, and while adjusting the trouble a well-known cry sounded far above in the air, which at once banished all desire to sleep. I knew the note quite well. It denoted the arrival of sandhill, or whooping, cranes from the north. Twenty-five years before I had seen them on the western prairies lift themselves on fixed wings above the clouds, and I had no doubt but what the call proceeded from birds which had the evening before been in the region of the great lakes of our northern boundary. Before sunrise at least fifty had arrived, and were greeted by their comrades on the land in the interior of the key. They came down in great circles from a height of not less than three miles, on tensely stretched wings, until within 200 feet of the earth, when they suddenly began a slow flapping which continued to the ground. I had often seen them begin their migrations, but never before witnessed the ending. They would average a weight of ten pounds, with about eight square feet of wing surface. In rising they slowly beat the air until a suitable elevation is reached, when they assume a fixed position and continue their upward flight in great circles to a high altitude, when they swing off at a tangent for the south. I have never seen one of these birds move its wings after stopping them in its ascent, until they had arrived at the same level in alighting.

The buzzards were the best species for observation from the ground. Their patience was simply inexhaustible. I watched a small flock of these birds for fourteen consecutive hours while they floated in the breeze, waiting my removal from a dead porpoise stranded on the beach. Nothing could surpass the loveliness of the day nor the bland freshness of the incoming breeze. The birds would average eight feet in spread of wings, would weigh six pounds, and have about six square feet of wing surface. A memorandum book was filled with notes of the day's experience. About a score of flaps were made between twelve and three o'clock in the afternoon when the wind was quite active and filled with flaws. From four to six in the evening they were as motionless as if petrified. As the sun disappeared behind the waters of the Gulf, I ended the hardest day's work I ever made, and was not fifty feet away before every bird had its beak in the carcass. For several days after this really imprudent exertion of the attention I was abed, but on resuming the subject determined to try an experiment. Before my eyes, assisted by a very good

glass, several bodies, of six pounds weight each, had remained stationary in free air about thirty feet above the water, absolutely without any visible support. They had remained in that condition many hours, facing a breeze of velocity varying from five to twenty-five miles per hour. In the rear was located my device for determining horizontality of wind, and it was level the entire day. Most people would be less surprised at a body resting in this way in calm air than in wind. They would hold each to be simply impossible, but more mysterious that both gravity and air-resistance should be ignored, than simply gravity. So to determine how much force it would take to keep six pounds in air all the time unsupported, I provided a billet of wood of that weight, well rounded, and proceeded to throw it up in still air, and the moment it came down, catch and return it. The work was honestly done; the moment it descended it was tossed back with all the activity I was capable of commanding. I prefer that each one should try this for themselves, and will only say that an hour of such work was far, very far, beyond my muscular capacity.

These birds were often watched from a perch in some lonely tree at the water line. That I could recline at ease in the fragrant foliage of the pine was easily accounted for; the trunk of the sturdy tree antagonized the gravitating force of my body, and I could rest at peace. But what held up the birds? Had gravity ceased to act upon them? Had they no resistance to offer to that sea-born breeze?

After about four years of this kind of work accident favored me. A summer whirlwind, on a calm morning, issued from among the lemon trees straggling over the point a few hundred yards below, and clutching an armful of dead leaves made for the bay obliquely in front of my station in the tree. A pair of buzzards were returning from the outer beach on fixed wings, and as luck would have it, were intercepted by the cyclone, and in five seconds were ducked in the waters of the bay. I hope they possessed a sense of humor, but they seemed to blame me for the mishap. A more thoroughly laughable episode I never witnessed, and from the bottom of my heart forgave the creatures for their seeming injustice. They abandoned that part of the coast but left their secret behind them.

For the purposes of this paper enough has now been said as to the facts exhibited. It is very evident that a state of things has

been found to exist which calls for something better than guess-work in way of explanation. Taking the case of a ten-pound bird with tensely stretched and motionless wings, facing a breeze anywhere from two to one hundred miles per hour, and resting serenely over the same spot of earth, without effort and without fatigue, we find our habitual notions about the difficulty of keeping unsupported substances in the air at fault. We want a solution of the matter from the standpoint of the mechanical engineer. We need not go into the domain of molecular physics for answers, but we wish the bird explained in the same way that a steam-engine is explained when we examine it as a machine doing work. To this end we may ask three questions, and satisfactory answers being found thereto, the phenomenon will be comprehended.

1. From whence is derived the motive power to balance gravity?

2. From whence is derived the motive power to hold the bird against the wind?

3. How are these forces applied?

To explain a steam-engine in this same sense but two questions demand answer.

1. From whence comes the motive power to drive the piston?

2. How is this force applied?

When we say that the force which moves the engine comes from the coal that is burning in the furnace, and is conducted through pipes by the medium of steam to a movable piston which it sets in motion, we have, in a general way, given an explanation to the activities there going on. When we say that the grindstone is operated by the force derived from the muscular organization of the boy turning it, then its action is also explained briefly.

It is in this way that an attempt will be made to explain a soaring bird. No objection is taken to the view that force cannot produce motion, held by some recent scientists. Granted that nothing but motion can produce motion, and I am then only concerned with the sequence of events; with having it understood that the motion of the piston is not the cause of the burning coal, nor that the grindstone turns the boy.

When the trifling tornado struck the birds as above related, the mechanical activities going on between bird and air were

thrown into confusion, and the gravitating force of the bird's mass instantly carried it to the water. It was evident that the internal adjustments to environing conditions, going on through a line of ancestry reaching to the reptiles of the secondary age, omitted summer cyclones. They were too rare to count. It was also pretty clear that the gravity of the bird's mass was the source of the entire motive power concerned in the act of soaring.

Were we dealing with wind-mills, sailing vessels, tornadoes or any other phenomenon in which the air was one factor and a body connected with the earth the other, the force would properly be spoken of as coming from the air. The amount of force would vary with the velocity of the wind. The work done would be referred to the mechanical agency which set the air in motion. But a body suspended in free air is part of the atmosphere, and at rest with it, unless it employs some activity not derived from it. The same mechanical agent which moves the air equally moves the body. The active birds derive the force to move themselves in the air from their muscular efforts, the soaring birds from gravity. Gravity gives *all* the motive power; that which antagonizes itself and that which antagonizes air resistance. The case is analogous to that of a man on a moving train of cars. He is at rest with the train throughout unless he employs muscular power to set up motion with it. All activity between man and car is due to the man's force and not to the train's force. His force works a pair of legs which set up motion. Gravity works in a different way. It requires a device which compresses air as found in the soaring birds.

Notice also that the mechanical action known as "soaring" takes place only between the minimum and maximum velocities with which body and air meet. An initial impulse is required in all cases to carry the body within those limits. In a calm, the body would have to be pushed on the air until the minimum was reached. In a breeze it would be forcibly held to reach the same result. The first impulse resembles pushing an engine off of the dead center. It simply starts the machine. It has nothing whatever to do with its continuous running. Once within the limits of "soaring," the gravitating force of the body gives a liberal supply of power for all the purposes of air navigation.

Let us suppose the wing surfaces to be twelve inches in width and the bird to weigh ten pounds, with wing expanse sufficient

to soar in wind moving at the rate of thirty feet per second horizontally. Why does not the body fall? It is true that there is a stiff wind moving against it horizontally, but the gravitating force is vertical and can be in no way influenced by a horizontal force. The ball shot from a level cannon falls precisely as fast as one dropped from the mouth of the gun. It is evident that the body is indifferent to the horizontal air. This does not act upon it at all. No particle of air influences it but what is in contact with its surface, and the instant it is in contact it ceases to be horizontal, being deflected in numberless different directions. In a strict sense, in a sense which alone represents the true character of this phenomenon, the air can only be considered as quiescent in every case of soaring. In every case the air is a dead calm until it comes in actual contact with the body, and the movement of the body on the air is a consequence of force derived from the body and not from the air. It is a parallel case with the boy and grindstone. From the reciprocal nature of action and reaction, the air is doing as much work on the bird as the latter is on the air. The grindstone is doing as much work on the boy as he is on the grindstone, still it would never do to say that the latter turned the boy.

If gravity, then, be the motive power of a soaring bird, how does it act to produce the results? Vertically downwards towards the center of the earth precisely as it does in all other cases, and the reason that the body manifesting it does not get lower, is because something is pushing up, against the under surface, just hard enough to balance the weight. It may be hard to follow all the peculiarities of the disturbances going on under the bird, but it is certain that they serve to hold it up. They are mainly condensations of air upon which the body is falling, and are equal to ten pounds in each foot of air passing to the rear. This ten pounds of force is moving at the rate of thirty feet per second, as we assumed at the start, and it follows that an amount capable of holding up 300 pounds each second is passing the rear edge of the bird's wings and is wasted in falling to the tension of the surrounding air.

But this is not all the force of disturbance which passes to the rear. The reactions against air resistance also go there. These, like the others, consist in condensations, accelerations and deflections. According to the law of the composition and resolution

of forces they bear the same relation to the vertical disturbances which the height of the incline bears to the base, or, in other words, they are to each other as the angle of inclination of the resolving planes. Supposing in this case the height to be one-fifth the base, there would be 360 pounds of force passing the rear of the bird's wing each second. Gravity puts in 300 pounds and gets itself supported in doing it. The weight is thus balanced; but we are employing an external force of sixty pounds to push the body on the air. By the law of the action of elastic fluids under pressure, when the condensed air passes the rear edge of the wing surfaces it expands in all directions, and consequently upwards and forwards on that edge. If sixty pounds of the whole 360 expanding is thus thrown forwards, it will balance air resistance, and the total power to produce the soaring phenomenon will be the weight of the bird. It only requires one-sixth of the whole force on hand to do it. If this can be utilized by wasting the other five-sixths the task is accomplished. There would be waste in eddies and side currents, so that in reality there would be less than the total force of disturbance passing to the rear. Allowance may be freely made for all wastage and sufficient will remain to perform the desired service. Experiment shows that in very critical tests the result can be attained without the rear expansion. It may be held that each molecule of air as it is struck by the plane is, to some extent, carried with it, as well as condensed, while those below are at rest. Thus a rotary motion may be supposed to take place on the entire lower surface, when the air-resistance factor would be neutralized by the excess of gravity in each molecule instead of at the rear edge.

It has been objected that this is a disguised form of "perpetual motion." Remember that there is a great difference between heaping absurdity on a thing and finding absurdity in it. It is urged that gravity can only do work by the fall of the body manifesting it, and that in this case it does not fall; that there is no sacrifice of its energy of position, and hence it cannot do work. This is true of actions in which the earth, or anything fast to or supported by it, is a part, and the gravitating body another part; and it is true in the sense that the word "fall" means getting nearer the earth. But this is not true with soaring nor with allied phenomena, and I will illustrate the matter by an example. Suppose that our hypothetical bird rests in the air in a horizontal

position and that the wind moves vertically upwards against it at the rate of twenty feet per second. To get the attention on the significant features of the case, we will suppose the bird to weigh the same as the air which it displaces, thus obliterating the gravity factor. It will then have no motion with respect to the air, but will move with it. In this condition it is not a falling body, and is doing no work. It is simply a body resting motionless in air. We will now suppose ten pounds of weight to be added to it. It instantly becomes a gravitating body doing work on the air. Its motion is accelerated until a velocity is reached at which the work done on the air is equal to the force doing it, when its motion becomes uniform. Suppose this to be twenty feet per second. What have we? A case precisely analogous to that of a soaring bird, which is a falling body doing work on the air without losing its energy of position. Its "fall" is properly related, in a strictly scientific sense, to that upon which it is moving, and upon which it is doing work. In relation to the earth, or the moon, or the seven stars it may be at rest, as they are not even remotely concerned in the matter.

A soaring bird may therefore be considered a machine for disturbing air. The motive power required for driving the mechanism is its gravitating force. Its effectiveness consists in the amount of disturbance which returns to the normal condition of the surrounding atmosphere.

There are two peculiarities connected with its action, which may be considered accidental or rather incidental, which deserve attention, for they are of the first importance in all questions relating to artificial air navigation. One of them is, that the material upon which the machine does work becomes the frame which supports it, and which is not connected with the earth in any way. The other is, that while the motion of the device is in all cases in two directions on the air upon which it operates, viz., in the direction of the gravitating force and at right angles to it, in respect to the earth's surface its motion is in any direction whatever indifferently. These two unique characteristics of soaring constitute its value for artifical use. They are the results of the action of an inclined plane driven on air, and meet the requirements of atmospheric translation completely, so far as the direction of motion and supply of motive power is concerned. It effectually disposes of balloons to antagonize gravity, and of

motors to drive the machine against the air. Two requirements are still needed. The device must be steered and kept in position. When it is remembered that the rear expansion drives the bird forward, any change in the extent or position of one wing which is not shared by the other would retard or accelerate the motion of the changed side relatively to the other, and serve to determine the direction of motion. A balance still needs to be preserved. The bird gives significant hints here also. The heavier it is the steadier is its motion, and a device large enough to sustain the weight of a man may be qualified by its inertia to assist in preserving its own equipoise.

The most important points of this subject have now been given. Experiments with artificially induced currents of air, requiring a steam-engine to be transported to the sands of Florida, were expensive and productive of only negative results. Much time and means were wasted in this way, and all my efforts previous to the summer cyclone above recited seemed abortive, excepting in the settlement of the facts of soaring as shown by the birds. The moment the idea that gravity was the motive power and not the air, was entertained, the whole matter became luminous. No steps subsequently taken have been in the wrong direction, and I shall return to the prosecution of the subject the moment prudence permits.

The relation of the soaring birds to artificial air-navigation fills the whole subject with a sort of pathos. A turkey-buzzard, most despised of all the birds, employs mechanical activities by using a device of such simplicity that compared to it a common grindstone is a complex machine, for the purposes of air-locomotion in the search for carrion, with conspicuous and complete success, itself being a working model of the very thing which man has worked, and sweated, and died to possess, and he has never seen it!

For a period of time coëval with his own existence on this planet this thing has been going on, and the world is full of it now, and still the mature conviction of both common sense and science is, that it is impossible.

# THE SIGNIFICANCE OF THE "COLLAR BONE" IN THE MAMMALIA.

BY SPENCER TROTTER, M.D.

WHEN running through a series of forms in animal life a structure is found fully developed in some and in others rudimentary or entirely wanting, we are led to consider the causes acting upon the structure through the life of the animal which has brought about the condition of development or non-development present. Every fully developed tissue in an organism is needed or it would not be there; and just so soon as by increasing change in life and habits, it becomes a factor of less and less importance to the animal; it fails more and more to attain its former standard of development, and in time falls back to the primitive condition from which it arose and finally disappears.

The "collar bone," or clavicle is an unstable factor in the shoulder girdle; by this I mean an element not always found present throughout vertebrates, and its presence, absence or rudimentary condition, is in relation to the life of the animal.

In this article it is my intention to note, principally among the mammals, the relation which the clavicle bears to the various modes of life, but before taking up the consideration of individual forms, reviewing briefly the general anatomy of the part.

The shoulder girdle consists first of the scapula, or "shoulder blade," a more or less irregular plate of bone preformed in cartilage and ossifying from two centers, the dorsal or scapular, the ventral or coracoid, in position against the anterior thoracic ribs, its long axis varying in inclination.

Its ventral end terminates in the "glenoid cavity," a ridge and process, *spinous* and *acromion*, on its outer surface are more or less developed in different forms, and in all mammals above the Ornithodelphia the coracoid is reduced to a mere process.

Second, the clavicle, when present, preformed in fibrous tissue extends as a bar of bone from the acromion process above the glenoid cavity to the manubrium sterni, forming a strong support to the girdle and an extended surface for ligamentous and muscular attachments. Mechanically considered the shoulder girdle (by using the term "girdle" both sides of the body are implied) is nothing more than the fulcrum of which the fore limb is the lever of the third kind, and its specialization is in direct relation

to the amount and character of the work done. The clavicle first appears in the ganoid fishes as a secondary apparatus developed in connection with the primary cartilaginous scapular arch. In the teleost or bony fishes it becomes a more important element in the shoulder girdle, having connection with the skull and the opposite sides joining in the ventral median line.

It undergoes a reduction and becomes of less significance in Amphibia and Reptilia, but in birds it assumes an important position in relation to flight, the entire shoulder girdle in fact being specialized to meet the conditions incident to aërial locomotion. The coracoids—large, strong bones—act as braces; the clavicles, peculiarly modified, are united at their sternal ends into one bone, the furculum, or "merry thought," which, as Owen has pointed out, acts as an elastic, bony arch opposing the force incident upon the downward stroke of the wing in flight, thus aiding the humeri, or arm bones, to regain their former position in the succeeding upward or counter stroke with as little loss of time and energy as possible. In terrestrial forms (grouse, fowls, etc.), where flight is sustained for short intervals only, the arch is narrower and the structure more slender and delicate.

Taking up the Mammalia with a view to ascertaining the relationship existing between the development of the clavicles and the work done by the fore limbs, let us start with the following general proposition as a basis for our observations, namely, that those animals which have the fore limbs specialized over the hind limbs in relation to work, possess a clavicle, and where the hind limbs are the most highly specialized, the clavicles are rudimentary or entirely wanting.

Leaving the ornithodelph mammals (the Australian duck-bill, Echidna, etc.), with their bird-like shoulder girdle, we note the presence of more or less well developed clavicles in all the marsupials, with the single exception of the "bandicoots" (Peramelidæ), where it is wanting, and its absence may be accounted for from the fact that the bandicoots from their terrestrial mode of life, nesting in hollow places and feeding on insects, roots etc., have for a long time had their fore limbs subjected to less complex conditions than the arboreal and predatory families, the opossums (Didelphidæ), the Dasyuridæ, the phalangers (Phalangistidæ) and the kangaroos (Macropodidæ), which constitute the rest of the order. In the kangaroos the clavicles, though pres-

ent, are slender and delicate, the weak fore limbs coming into use in manipulating the "pouch," etc., thus throwing a variety of motion into the shoulder joint, which explains the presence of clavicles in an animal whose locomotion is almost entirely performed by the hind limbs.

Among the Insectivora, a large order of wide geographical range and rather uniform life, the majority of species being terrestrial and fossorial or burrowing, we have the clavicles well developed with but one exception, that of *Potamogale velox*, a rare form from Western Africa, and this is the only insectivore which is almost entirely aquatic. It measures about two feet in length with a long cylindrical body, tapering continuously into a thin, laterally compressed tail, which is the main propulsive power when swimming, the short legs with their unwebbed feet drifting back against the body. Another form, Myogale, from the streams of Southeastern Russia, is natatorial and possesses a clavicle, but the feet are all webbed and come into play along with the tail as organs of propulsion.

The moles, Talpidæ, are eminently fossorial, their excavations being everywhere known; an East Indian squirrel-like form is arboreal; all the rest are terrestrial and fossorial.

The order Edentata is divided into two primary groups, the "leaf-eaters" (Phytophaga) and the "insect-eaters" (Entomophaga). The Phytophaga comprise the "sloths," curious, arboreal forms inhabiting the South American forests, represented by only two living genera; they are entirely arboreal, making characteristic progression among the tree-tops on the leaves of which they feed. In the two-toed sloth, or "unau" (Cholœpus), the clavicles are well developed; in the "ai," or three-toed variety (Bradypus), they are small, rudimentary, having lost their sternal attachments and evidently undergoing a retrogressive change, due probably to some variation in the animal's life and habits which brings the part into less active use.

In the Entomophaga (ant-eaters, armadillos, etc.) we find the clavicles fully developed in the climbing two-toed ant-eater Cyclothurus, a small South American species; also in the Cape ant-eater, or "aard-vark," Orycteropus, a burrowing form from the Cape of Good Hope; while in the great ant-eater, Myrmecophaga, a strictly terrestrial form but not fossorial, the clavicles are absent, the long claws tearing open the ant hills and termites'

mounds, and the narrow, flexible tongue securing the food, stand in place of the burrowing habit, thus bringing the shoulder joint under much less active conditions. In the South American armadillos, which are more omnivorous and are "diggers," the clavicles are developed. The "pangolins," scaly covered animals, mainly terrestrial and rolling themselves in a ball on the approach of danger, have no clavicles.

In the order Rodentia we find all the Sciuromorph group with fully developed clavicles; the squirrels are either arboreal or burrowers; the marmots, Arctomyinæ, are typical burrowers, while the beaver, though eminently aquatic, brings the fore limbs into active use in the construction of its dams and lodges.

The Myomorpha (rats, mice, gophers, etc., typical gnawers and diggers) have well developed clavicles, the gnawing habit bringing the fore limbs and shoulder girdle actively into use to steady the head and neck and the object which is being worked upon.

In the Hystricomorpha (porcupines, cavies, etc.) clavicles are found developed in the climbing tree-porcupines (Sphingurinæ), of which our Canadian species (Erethizon) is a member, and absent in the large African porcupine and all others of the Hystricine group, which is strictly terrestrial but not fossorial.

The chinchillas have well developed clavicles, the horse-tripping burrows of the "Pampas Viscacha" being too well known to the riders of that region. The agoutis (Dasyproctidæ), inhabiting the banks of streams in the South American forests, semi-aquatic and sub-ungulate (*i. e.*, having the feet partially encased in a horny sheath or hoof) have rudimentary clavicles. The Caviidæ (guinea pigs) and the "capybara," the largest living rodent, semi-aquatic, with webbed feet, have imperfect clavicles.

The Lagomorpha consists of two living families, the Lagomyidæ, small burrowing animals called "picas," inhabiting Alpine regions, and the Leporidæ (hares and rabbits); the former family having well developed, the latter rudimentary clavicles. The hares are typical runners, solitary, never burrowing, depending for safety in speed and making their characteristic "form"; the species known as the rabbit, however, differs largely in habits from the other members of the family, being more or less gregarious, living in "warrens" which it burrows out, and having much less capacity for speed. Clavicles are developed in both;

very rudimentary in the hares, and in the rabbits existing as a bone incomplete at the ends, a condition which we would expect to find from the variation in life habits.

Taking up the large order of "hoofed" animals, the Ungulata, we note the complete absence of the clavicles in all the forms, not a vestige of the bony structure being found in any one of them. They are the "runners" *par excellance*, and if we may use the expression, *live on their legs*, the capacity for speed and endurance being one of the chief factors aimed at by natural selection in maintaining and perfecting the species.

Here we find the fore limbs subserving the hind limbs in relation to work; the latter are the main motor power in running, while the fore limbs act chiefly as supporters and guiders; hence the entire absence of clavicles. The marine Mammalia, with their rudimentary limbs, have no clavicles.

In the flesh-eating animals, Carnivora, the clavicles are always rudimentary, and in many cases entirely wanting. They are better developed in the cats, Felidæ, than in any other family of the order (though the articular extremities of the bone are lost), for the clutch which follows the spring in securing their prey, brings the fore limbs into more active use than in the dogs and wolves, Canidæ, which run their quarry to "the death," and then pull it down by force of numbers. Many of the cats, too, frequent trees, but they spring from place to place and do not properly climb. Several species of bears also climb, but the habit is more acquired than natural, the fore limbs clasp the trunk while the hind ones secure a foothold and, so to speak, shove the animal upward, very different from the active movements of a natural climber.[1]

In the bats, Chiroptera, as we would expect from their mode of life, the anterior limbs being the main factors in their flight, clavicles are developed, long, curved and strong.

The arboreal Lemurs also have them developed.

In the order Primates we have the clavicles present in all, from the arboreal monkeys up through the anthropoid apes to man, where the anterior limbs attain such perfection, with ball and

[1] The badger (Taxidea) is a striking exception to the general rule, being an eminently fossorial animal yet devoid of clavicles. The fore feet are armed with exceedingly long, slightly curved claws, probably bringing greater leverage on the wrist and elbow joints and thus partially supplementing the absence of clavicles.

socket shoulder joint capable of such varied and extensive motion, with a high degree of pronation and supination of the fore arm, and last, but not least, the wonderfully specialized hand with its thumb opposable to each of the four digits.

After this brief survey, and with the forementioned proposition in view, viz., the correlation existing between the development of the clavicle and the work done by the fore limbs, we are left to draw the rational conclusion that the subject under consideration is one of *use* and *disuse* of parts, as Darwin has so clearly pointed out in his chapter on rudimentary organs in the Origin of Species. The facts we have noted in our hasty glance at the Mammalia confirm this, in the more or less perfect development of clavicles in arboreal, fossorial, aërial and all other forms where the fore limbs are the active, aggressive pair in the life of the animal, and their absence or rudimentary condition in the hoofed animals, the marine species and all others where the anterior pair take a secondary place in the work done by the limbs.

As there is, of course, no actual disuse of a part as a whole (the nearest approach to this being in marine forms), a simple, uncomplicated motion existing, with little strain at the shoulder joint, the parts require less support and fewer points for ligamentous and muscular attachment than where the movements are more complicated and the strain more severe. Consequently we have a greater or less differentiation in the elements of the shoulder girdle as the case may be, and the clavicle, holding as it does a position of secondary importance, is the unstable, variable element.

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## PEAR BLIGHT AND ITS CAUSE.

BY J. C. ARTHUR.

PEAR trees in this country are subject to an endemic disease that, owing to its malignancy and frequent occurrence, is well known to cultivators and fairly well discriminated by them. It is known both as *pear blight* and *fire blight*, and the same disease in the apple and quince is also called *twig blight*. The term blight is applied to many kinds of plant diseases, and especially to those that eventually kill without rendering the cause conspicuous; it is also the name of a class of disease-producing fungi. The pear malady bearing this name is, however, a specific disease, although

it would be a matter of considerable difficulty to describe it in such diagnostic terms that the reader would recognize it under all conditions and avoid confounding it with the numerous other blights and incidental maladies which resemble it. Its most characteristic feature, if one considers only pomaceous trees, such as the pear, apple, quince, crab, hawthorn, etc., is the complete dying of the branches subsequent to the appearance of the foliage without obvious cause and usually with apparent suddenness. This involves the limb and its leaves, both of which turn blackish and usually exhale a peculiar but not very strong odor. From the softer stems there often exudes a viscid, whitish substance forming small drops on the surface of the bark and finally becoming hard like an exudation of gum.

The blackening of the dying branches does not differ from that produced by death from other causes; hence arises the danger of mistaking other injuries of the tree for the true blight as here understood. Death may be brought about by the limb being partly broken off, or it may be punctured and killed by the pear-blight beetle (*Xyleborus pyri*), a very small insect which often escapes detection, or it may result from other mechanical injuries. There is also the blackening of the ends of young twigs in spring known as frozen-sap blight, the blackening of the edges of the leaves later in the season, more common on some varieties, *e. g.*, the Sheldon, than on others, and so on. But the real blight kills the limb in advance of the leaves, and will usually show the blackened bark, when raised with a knife, below the lowest dead leaves; the gummy exudation, when that is to be found, is abundant confirmation. In addition to this, the extent of the malady, sometimes embracing the larger part of the tree and most of the trees of the orchard, assures one of its identity. Pear leaves may at times assume a deeply bronzed appearance and the bark become dark colored, but these appearances need never be mistaken for blight, as the tissues beneath will be found normally green and healthy.

The disease is most observed during July and August. It may manifest itself upon any part of the tree, but starts rather more often at the ends of the main branches, and will first attract attention by the dead leaves. All above the affected parts will usually die, and if the branch is not removed the disease will gradually extend toward the trunk of the tree. It is purely a local disease,

and affects no part of the tree but the branches attacked. Sometimes a whole tree is killed, but usually only certain limbs die, which if early removed will leave the remainder of the tree in normal condition. The progress of the disease along the limb is variable, but in general is greatest during the hottest weather; in winter it moves slowly, even advancing but six to twelve inches during a whole cold season. The advent of spring, quite contrary to what one would expect, usually checks the disease after it has defied the rigors of winter, and by the time the tree is well clothed with leaves is brought to an end, not to be again revived.

So extensive and prominent a disease of an important fruit tree, and one entailing heavy pecuniary losses during epidemic years, has naturally been the occasion of much discussion. Its cause being obscure and the manner of its incursions and spread mysterious, it was variously ascribed to the soil, the weather, the electrical influences of thunder storms, to undiscovered fungi, and many other agents. These attempts at explanation were all unsatisfactory, failing to account for many of the phenomena connected with the disease.

The first substantial advance toward a solution of the question was made by Dr. T. J. Burrill in his memorable announcement in 1880 to the American Association for the Advancement of Science that he had discovered bacteria in invariable connection with the disease. The same discovery was reiterated by the author in an article in this magazine for July, 1881. He also proved that the disease is infectious and may be communicated to healthy limbs by inoculation, using the gummy exudation as a virus either with or without dilution with water, and not only to pears but to apples and quinces as well.

No additional discoveries of note were made till the investigation, which is still continued, was taken up by the writer in July, 1884. The subject need not be further treated chronologically, as a clearer and more concise statement can be made by giving the present condition of our knowledge irrespective of the order of its acquisition.

The term bacteria is a generic one, and covers many forms exhibiting great morphological and physiological differences. The form causing pear blight does not belong to the genus Bacterium, as one might infer, but to the genus Micrococcus, and bears the

full name of *M. amyliovorus* Burrill. Members of this genus are globular, or somewhat longer than broad, either single or in short chains of a few individuals; they multiply by a transverse division, each half growing to the size of the original from which it was derived, and finally becoming an independent cell. The formation of spores does not occur, or at least has not been discovered, in this genus; no transformation takes place.

The pear blight Micrococcus is oval in outline and measures 1 by 1½$\mu$, which is .00004 by .00006 inch. This is extremely small, so small, in fact, that it would take more than a thousand placed end to end to reach around the period at the close of this line. They are considerably smaller than the bacteria of common putrefaction (*Bacterium termo*), the hay bacteria (*Bacillus subtilis*) which usually appear in all sorts of vegetable infusions, and many others. On the other hand they are by no means so small as the germs of diphtheria (*Streptococcus aiphtheriticus*), of smallpox (*S. vaccinæ*), and others. When in active growth they are single or attached to each other in pairs, dumb-bell form; when growing more slowly there is a larger proportion of the dumbbells, and in addition chains of four to six cells each.

Although these bacteria are very small, yet there is no difficulty in demonstrating them in the tissues of the pear tree on account of their extraordinary abundance. The slightest fragment taken in midsummer from a blighted pear limb and placed in a drop of water will readily enough show the presence of bacteria to the unaided eye by the white cloud of them which spreads from the bit of wood throughout the water. Slice up some blighted wood into a small quantity of water and it will be rendered milky by the enormous outpouring of the bacteria. Under the microscope these are found to be all of one kind, and not intermixed with ordinary putrefactive or other bacteria, a circumstance which may yet be turned to account in studying problems in which an admixture of forms is detrimental. The exudation already referred to is found by the microscope to be composed solely of blight bacteria and a soluble substance which holds them together.

When in very vigorous growth the blight bacteria are active, and present an animated appearance under the microscope, but usually they have only the molecular movement common to all small particles suspended in fluid. Their progress through the

plant is doubtless largely due to simple displacement as multiplication takes place, although aided by the limited activity of the organism and the movement of the sap.

The change induced in the tissues of the tree partakes of the nature of a true fermentation. That we do not have to do with a putrefactive change is patent enough, as no offensive odor is given off. The disengagement of carbon dioxide may be made evident by partially filling a test tube with fragments of a freshly blighted limb and adding water enough to little more than cover them. In a short time bubbles of gas will be set free, and a drop of lime water held in the tube will show the presence of carbon dioxide by the whitening of its surface. It is not so easy to determine the nature of the other products formed. Careful and repeated tests give no indication of the occurrence of butyric acid. The presence of alcohol in very slight amount was shown by means of the delicate iodoform test. For this a nearly full-grown Bartlett pear, which was thoroughly permeated with the blight bacteria from an inoculation made a week before, but the tissues still undiscolored, was distilled and the distillate used for the test. The amount of alcohol found was so slight, however, requiring a microscope to find the crystals produced by the test, that it did not account for the main bulk of the product of the organism's activity. This product is presumed to be mainly gum of some sort, for the following reasons, *inter alia:* the solubility, adhesiveness, taste or rather tastelessness and the appearance upon drying. There is much probability, indeed, that this belongs to the viscid fermentations, which have been but little investigated.

The bacteria in the tree first attack the starch of the cells, then the cellulose of the cell walls, and finally the whole tissue becomes a liquid mass. When, however, the cell walls consist of lignin or other secondary substances they are not broken down. The action on the cell wall is best seen in the tender, unmodified tissues of the fruit.

After this survey of the characteristics of the organism and the chemical changes which it induces, it will be profitable to learn something of the nature of the disease itself. The usual impression has been that the disease is like a blast of superheated air passing over an orchard, leaving dead and blackened foliage in its track, or that it appears suddenly as the result of a thunder

storm following hot and damp weather. Its true nature, so different from these conceptions, has been learned by inoculating healthy limbs with germs from an affected tree and closely watching the progress of the disease through its whole course from inception to the death of the limb. The inoculation is made by puncturing the limb and applying some of the gummy exudation, or, better, a drop from a watery solution of it, or from water in which some diseased tissue has been sliced. If this be done in July and the inoculation be made in a young and tender shoot, the tissues near the wound will show discoloration in about a week, and in the course of a week longer the leaves and end of the shoot become blackened and dead. Let it be noticed that at the most favorable season for development it requires some two weeks from the time of the attack to enable the disease to gather sufficient headway to be conspicuous; for no observer is likely to detect the change in the color of the bark before the dying leaves have fixed his attention, unless he knows an artificial inoculation has been performed. This sufficiently disposes of the supposition that the disease is sudden in its action; still more marked proof will be adduced later, showing that in natural course it is slower yet. Over two hundred recorded inoculations have been made, and from these we learn that the disease makes the most rapid progress in the newest and most succulent tissues; and the nearer to a vigorously growing bud an inoculation is made, the more likely it is to succeed. In fact, it was soon found that no result was likely to follow an inoculation in wood a year or more old. This suggested the inoculation of growing fruit; the results were most surprising, for the tender parenchymatous tissues were entirely broken down into a creamy fluid, which now and then escaped at the wound made in inoculating and dripped upon the ground.

Repeated attempts to convey the disease by inoculating the leaves resulted in failure, except a partial success when very young leaves were tried. It is noticeable that the leaves are the last to succumb to the disease; they will remain green for days or even weeks after the bark at that point has become brown and dead. Bacteria cannot be found swarming in the leaves as in the bark and wood; the conditions do not seem favorable for their development. The conclusion is inevitable that the death of the leaves on a diseased branch is chiefly due to the cutting off of the supply of sap.

The investigations of Professor Burrill showed that the disease might be conveyed to the apple and quince trees also. Not only was this easily confirmed, but inoculations were successfully performed on the English hawthorn (*Cratægus oxyacantha*), the evergreen thorn (*C. pyracantha*), and the service berry (*Amelanchier canadensis*), while they failed on grape, raspberry, mulberry, peach, etc.; that is, they succeeded on members of the pear family, but not on other plants. The virus was from the pear, apple and quince, interchangeably, and showing no perceptible difference in the results that could be traced to the kind of virus used. The only differences to be noted were such as were obviously accounted for by the varying ripeness and solidity of the tissues. Unsuccessful inoculation was made upon the mountain ash (*Pyrus aucuparia*), but as the tissues were already solid when done, and as branches suffering with the disease have since been found, there is no doubt that it can be communicated if the inoculation be properly performed.

In the studies so far detailed the germs were artificially introduced into the branch; the problem of how they gain entrance naturally seemed for a time well nigh unsolvable. Virus smeared upon the outside of the branch, leaf or fruit had no effect; diseased branches tied among healthy ones under the most favorable circumstances for contagion gave no results; apparatus arranged to draw air across diseased branches upon healthy ones also failed; copiously watering a potted pear tree for a month with water white with blight bacteria had no deleterious action on the tree; and yet the germs must gain entrance some way, for it is inconceivable that they should originate spontaneously within the tree. Finally some light was secured by a series of partially successful experiments in which water containing blight bacteria was arranged to drip upon pear and apple twigs; the germs entered the twigs through the moist surface of the youngest tissues. A fortuitous observation now made the matter clear; it was noticed toward the end of June that the English hawthorns, which blossom very freely about the middle of May, were seriously affected with blight. At the time of observation the flowers had long since disappeared and the fruit was well advanced toward maturity. The blighted branches, however, were still crowned with dead flowers, and wherever the dead spur or branch was not terminated with a truss of flowers it showed

every evidence of having been arrested in the midst of rapid growth. The conviction was established that the germs enter the tree in spring through the moist glandular surfaces within the flower or the tender surfaces of expanding buds, but that the disease does not make sufficient progress to become conspicuous till the warm days of June or July. As the flowers drop and the branches cease extending less and less chance exists for the tree to take the disease. Insects may now and then transfer the germs, for two pears were found the present season filled with blight, in both cases showing the point of entrance, evidently a puncture made by an insect. It is only in some such exceptional way that the germs can gain admittance through the well protected surface of fruit.

If the germs pass from the air into the tree, in what manner do they get out into the air again at the proper time for the next season's attack? Manifestly the bacteria within the tree are securely imprisoned by the bark, which as effectually prevents their escape as it does their entrance; and at any rate, in spring, the time for attack, there are few bacteria left alive in the tree. Limbs with tender tissues exude great numbers of germs during July and August, but so agglutinated that the air cannot dislodge them, until the rains have washed them to the ground and dissolved the gum which binds them together. The query now presents itself whether the germs may not be able to thrive outside the tree. To test this, cultures were tried in various media, and it was found that infusions of hay, corn meal, starch and various other vegetable substances make a nutritive fluid in which the blight bacteria flourished in varying degrees, no matter whether the solutions were acid, alkaline or neutral. When transferred from the culture fluid to the tissues of the tree, the usual form of blight follows. This plainly indicates that the germs washed from the tree by rain may find congenial nidus among vegetable refuse, thrive and multiply, pass the winter, for cold does not injure them, even pass an unfavorable year or two, and at times being swept into the air be brought by gentle rains or an arresting film of dew into contact with the delicate surfaces of expanding shoot or flower and infection be secured.

Now having shown the progress of the disease to be coördinated with the development of germs and traced the life cycle of the germs, there may still be persons who do not believe that

germs cause the disease, but that they are merely accompaniments of it. To meet this objection, and place the subject upon a logical and irrefragible basis it is necessary to state the results of still further studies. In order to determine whether other bacteria will grow under the same circumstances, various kinds were inoculated into pear trees—bacteria from rotting spots in green tomatoes, from various sorts of putrefactions, those which had incidentally appeared in various culture experiments—and uniformly with negative results. When inoculation was made from a culture of blight bacteria contaminated with other forms, the resulting blight contained but the one sort. It is a well-known fact that most bacteria will not thrive in acid solutions, and Hartig has supposed that the reason that plants are so free from parasitic bacteria (only two, or at the most three, true vegetable parasites being known among them) is that they cannot withstand the acidity of the sap. Be this as it may, only one form of bacteria has yet been found to accompany pear blight.

But this does not dispose of the possibility that the blight is not caused by the bacteria, but by some deleterious substance which goes with them or which they produce. It is obvious that as the blight may be produced by using a drop of water which has been flowed over blighted tissues, the active agent must be either the bacteria or the substances which the water dissolves. There is a very simple way of separating solutions from bacteria by filtering through porous earthenware, which permits the fluid to pass, but not the bacteria. It has been demonstrated by trial that inoculating from a filtrate prepared in this way will not produce the blight. Separating the bacteria from all accompanying substances is accomplished by means of fractional cultures. Such a drop as used for inoculating is introduced into a suitable sterilized culture fluid; after some days, when the bacteria have well filled it, a drop is removed and used to start another culture, and so on. In this way the bacteria are kept vigorous by growth and multiplication, and the unvitalized substances which accompanied them in the first drop are more and more diluted at each transfer. Finally a drop from the last culture of the series, in which the amount of substance derived from the original drop must be so infinitesimally small as to be inoperative, is used to inoculate with again. Carefully conducted experiments of this kind have given as severe blight as in direct inoculation. No stronger proof is needed that the bacteria are solely responsible for the disease.

## EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

—— There is little difference of opinion among the scientific men of this country as to the great value of Government aid to scientific research. Not only is its importance obvious to them as craftsmen, but as citizens. It is not worth while to make nice theoretical distinctions between State and United States rights in this matter, for the great point is to secure, in the language of Smithson of illustrious memory, "the increase and diffusion of knowledge among men," and especially the men of this country. If the State governments are too indifferent to their own interests to foster the work, let the General Government sustain it. Its utility is two-fold. The one object which is alway obvious, is the exploration and exposition of the resources of the country. The other, no less important, but less understood, is the development and occupation of the intellectual force, activity and thought of the men of the country. The cultivation of man is the most important of human enterprises, and a republican form of government rests on a basis of such cultivation. The government aid to the universities of Germany is one of the principal assurances of progressive, or even continued, civilization which the world possesses. As the Government of the United States does not aid the universities of the country, it should not fail to sustain and develop its own system, which embraces the various scientific bureaus at Washington.

It has sometimes been objected that the great power of the Government treasury constitutes it such a rival, as to seriously discourage private enterprise in this direction. There are two reasons why this reasoning is fallacious. First, the field of science is so vast that no organization can cover it; there is always room for workers, especially at the top. Second, brains are not produced by money, and ideas are not for sale on demand. The thinker who produces ideas on $1500 a year, will only be too glad to have some one in Government employ to illustrate them with larger resources. Moreover there are some departments of scientific work in which the Government can have few or no rivals. These are the expensive enterprises which private persons can rarely sustain. Such are deep-sea explorations; harmonious geodetic surveys over wide areas; geological surveys in regions which are for some reason inaccessible or dangerous;

also excavations for fossils on any but a limited scale. The creation and support of scientific museums and laboratories must have the assistance of a heavy purse; and finally, governments have generally been the only medium of publication of results on any considerable scale.

Official science has, however, no shield of Achilles which shall protect her from the usual temptations of power and from the methods of politics. It is true that she more surely stands or falls on her merits than any other representative of human labor, yet as she is the teacher of mankind, who is to decide the question of merit? That she may become corrupted, so that the love of fame and power may supplant the love of knowledge, is not impossible. The man of politics can see and understand this, and whether true or not, charges against scientific men holding official position will be preferred, as in the case of other office-holders. The public press has on various recent occasions applied the term "political scientist," and has attempted to point out persons to whom the expression is appropriate. Although a "political scientist" is a conceivable person, the applications made by the newspapers have been wide of the mark. The term is not appropriate to a man because he secures large or small appropriations from Congress to be expended on scientific work. All honor to such men, whoever they are. Their country and the world owe them gratitude, not sneers.

If we were to seek to define a "political scientist" we would describe him as a man who sought the aid of the resources of the Government to hold an office for its emoluments or honors to which his abilities and services to science do not entitle him. In order to do this he will reproduce the ideas of others without acknowledgment; he will endeavor, through means well known to men in official position, to suppress criticism of his work, and thus to reach an eminence of popular reputation which is purely factitious. Such would be a man who might appear to fulfill the duties of his position by the employment of persons to do his scientific work for him. A "political scientist" would spend little time in his study, and a great deal of time with prominent persons of all kinds, gaining the "influence" that comes from personal representations in the many quarters where the merits of questions of science are unknown. The "political scientist" might flourish for a time in this country, and his existence would be a constant menace to the prosperity of Government scientific enterprises, and would react disastrously on the men of real merit.

—— The Legislature of Michigan has done itself discredit in the treatment of the last Geological Survey of that State. It removed Professor Rominger, a most competent man, and put in his place a man less known, who, however, has his future in his own hands. It refuses to publish the report of Professor Rominger,

although the money for this purpose is in the hands of the State treasurer. This money was saved from his meager appropriation by Professor Rominger, who thus offers to the Legislature a rare example of economy. The governing body of Michigan should recognize this fact by returning the money to their ex-State-geologist, and publishing the report without delay by a new appropriation. Professor Rominger has the endorsement of the geologists of the country.

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## RECENT LITERATURE.

ROMANES' RESEARCHES ON THE NERVOUS SYSTEMS OF JELLY AND STAR-FISH.[1]—The beautiful researches and discovery by Haeckel of a nervous system in Geryonia, consisting of true ganglion cells and true nerve-fibers, and the extension by the Hertwig brothers of our knowledge of the nervous system of Medusæ in general, especially the naked-eyed forms, marked a most important step in animal morphology.

These microscopical observations were, except Haeckel's discovery, forestalled by the physiological experiments of Professor Eimer and Dr. Romanes, who, however, worked independently of each other. In the present work Dr. Romanes gives a popular account of his own researches, with due mention of and credit to Dr. Eimer's researches in the same direction.

After having some account of the structure of the Medusæ, we are afforded the results of fundamental experiments. The author proved that excision of the extreme margin of a nectocalyx (or umbrella) of the naked-eyed Medusæ causes immediate, total and permanent paralysis of the entire organ. This result is striking and decided. Indeed, adds the author, "I do not know of any case in the animal kingdom where the removal of a center of spontaneity causes so sudden and so complete a paralysis of the muscular system, there being no subsequent movements or twitchings of a reflex kind to disturb the absolute quiescence of the mutilated organism. The experiment is particularly beautiful if performed on Sarsia; for the members of this genus being remarkably active, the death-like stillness which results from the loss of so minute a portion of their substance is rendered by contrast the more surprising." On the other hand the severed margin "continues its rhythmical contractions with a vigor and a pertinacity not in the least impaired by its severance from the main organism, so that the contrast between the perfectly motionless swimming-bell and the active contractions of the thread-like portion which has just been removed from its margin is as striking a contrast as it is possible to conceive." But though in the

[1] *The International Scientific Series.* Jelly-fish, Star-fish and Sea-urchins. Being a research on primitive nervous systems. By GEORGE J. ROMANES, LL.D., F.R.S. New York, D. Appleton & Co., 1885. 12mo, pp. 323.

vast majority of cases it was found that excision of the margin impairs or destroys the spontaneity of the animal for a time, the paralysis so produced was very seldom permanent. After a variable period occasional contractions are usually given, and in some cases they were resumed with but little apparent detriment.

Light was found a most marked and unfailing stimulus, and light *per se*, rather than a sudden transition from darkness to light. Hence it was satisfactorily proved that the "eyes" of these animals are really such, as the following experiment with others, proves:

"Having put two or three hundred Sarsiæ into a large bell jar, I completely shut out the daylight from the room in which the

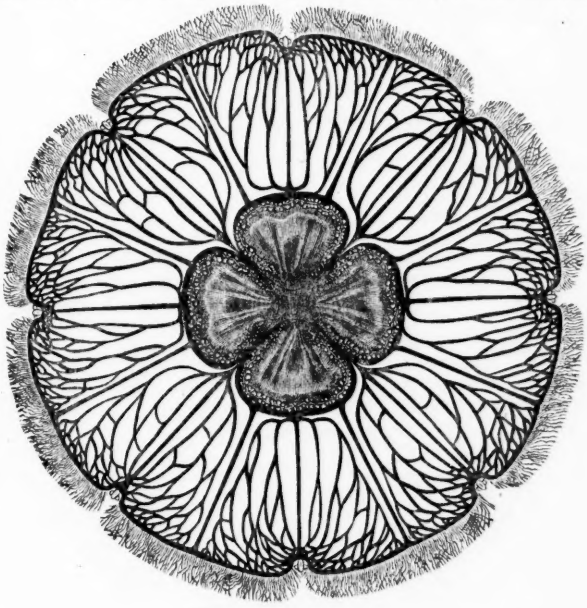

FIG. 1.—Aurelia aurita.

jar was placed. By means of a dark lantern and a concentrating lens, I then cast a beam of light through the water in which the Sarsiæ were swimming. The effect upon the latter was most decided. From all parts of the bell-jar they crowded into the path of the beam, and were most numerous at that side of the jar which was nearest to the light. Indeed, close against the glass they formed an almost solid mass, which followed the light wherever it was moved. The individuals composing this mass dashed themselves against the glass nearest the light with a vigor and determination closely resembling the behavior of moths

under similar circumstances. There can thus be no doubt about Sarsia possessing a visual sense."

Dr. Romanes then describes his experiments on the covered-eyed Medusæ to ascertain the amount of section which their neuro-muscular tissues will endure without suffering loss of their physiological continuity. In *Aurelia aurita* (Fig. 1) the nervous system is compared to a disk of muslin, the fibers and mesh of which are finer than those of the finest and closest cobweb, and if we imagine the mesh of these fibers to start from these marginal ganglia, we shall gain "a tolerably correct idea of the lowest nervous system in the animal kingdom." Now if seven of these eight ganglia are cut out, and the disk mutilated as in Fig. 2, yet the contraction waves, starting from the single ganglion

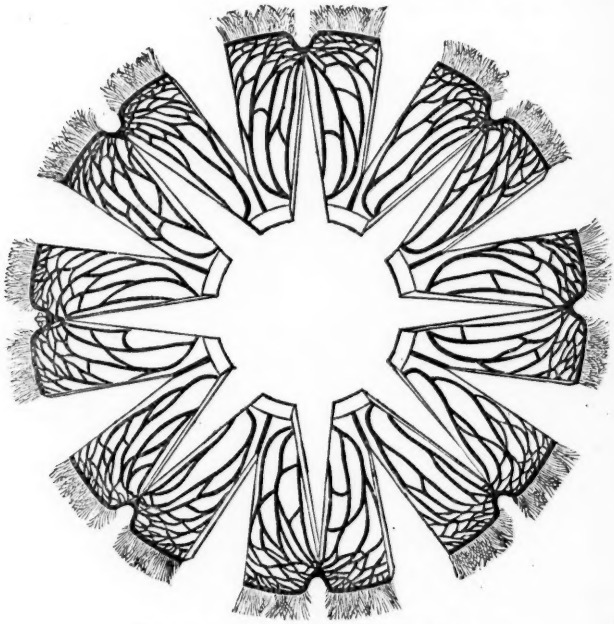

FIG. 2.—Aurelia, with its disk cut radially.

left, "continued to zigzag round and round the entire series of sections."

In a second mode of section (Fig. 3) the central space, *x*, was excised, the circular cut, z, made, leaving the isthmus, *z*, and all the eyes, or lithocysts, were removed except the one at *l*, yet the contraction waves, emanating from *l*, passed in the direction represented by the arrows without undergoing any appreciable loss of vigor. Upon completing the circular cut at *z*, the ring of

tissue (*yz*) became totally paralyzed, while the outer circle, of course, continued its contractions as before.

Lastly a third mode of section was made (Fig. 4); a long strip removed, with the eye and its ganglion at one end and the rest of the swimming-bell at the other, the latter contracting, and such a strip may be made a yard long, but still the portion of the swimming-bell continues to contract. From these experiments and the histological studies of Professor Shäfer, it is seen that the "nerve fibers which so thickly overspread the muscular sheet of Aurelia do not constitute a true plexus, but that each fiber is

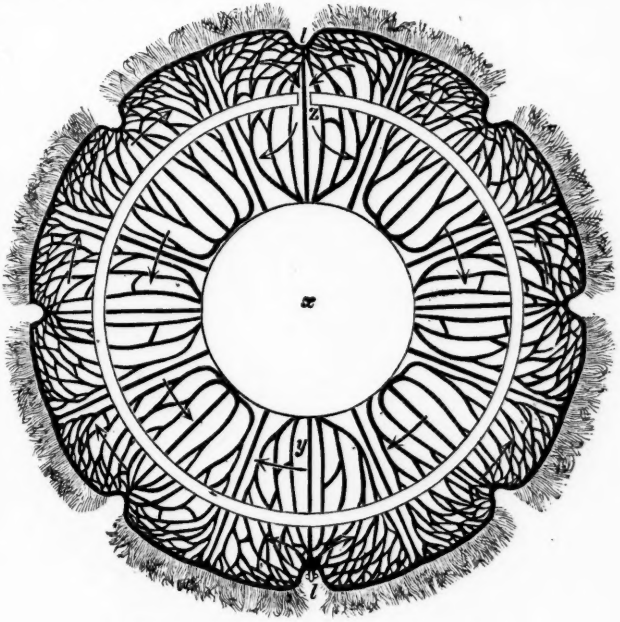


FIG. 3.—Aurelia with a circular cut *z*.

comparatively short and nowhere joins with any of the other fibers; that is to say, although the constituent fibers of the network cross and recross one another in all directions—sometimes, indeed, twisting round one another like the strands of a rope—they can never be actually seen to join, but remain anatomically insulated throughout their length. So that the simile by which I have represented this nervous network—the simile, namely, of a sheet of muslin overspreading the whole of the muscular sheet—is, as a simile, even more accurate than has hitherto appeared; for just as in a piece of muslin the constituent threads, although frequently meeting one another, never actually coalesce, so in the

nervous network of Aurelia, the constituent fibers, although frequently in contact, never actually unite."

Space forbids farther abstracts of the book. The author discusses the regeneration of tissues, the excitable tissues of these animals regenerating themselves after injury with astonishing rapidity. Experiments were made in section of naked-eyed Medusæ; on the coördination of movements, and on the natural and

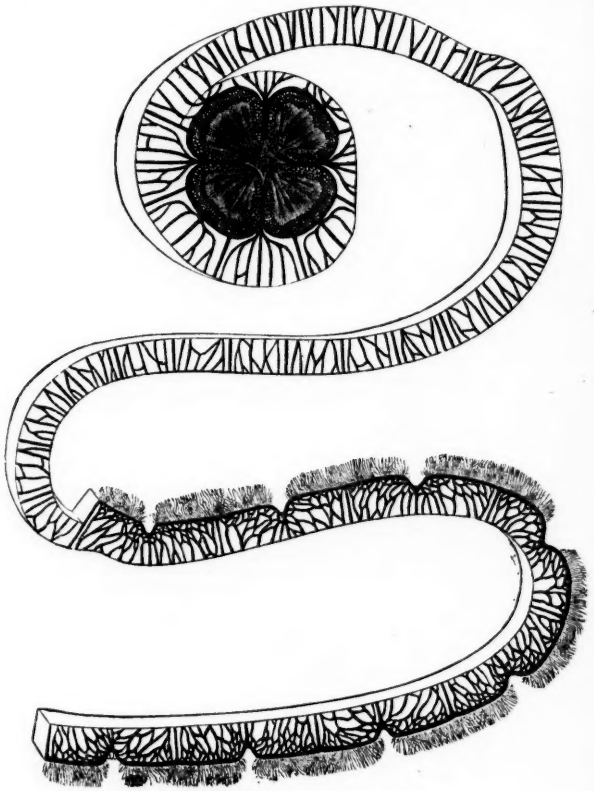

FIG. 4.—Third mode of section in Aurelia.

artificial rhythm in the pulsations of Medusæ. The effect of poisons is discussed at length, particularly the effects of a change from salt water to fresh, as illustrated by the fresh-water Medusa, *Limnocodium sowerbii* (printed *sorbii*), of the tank in Regents Park (Fig. 5). It appears that a much less profound physiological change would be required to transmute a marine jelly-fish into a jelly-fish adapted to inhabit brine, than would be required to

enable it to inhabit fresh water, and it is concluded: "If an animal so exceedingly intolerant of fresh water as is a marine jelly-fish may yet have all its tissues changed so as to adapt them to thrive in fresh water, and even die after an exposure of one minute to their ancestral element, assuredly we can see no reason why any animal in earth or sea, or anywhere else, may not in time become fitted to change its element."

The book closes with an interesting chapter on the movements

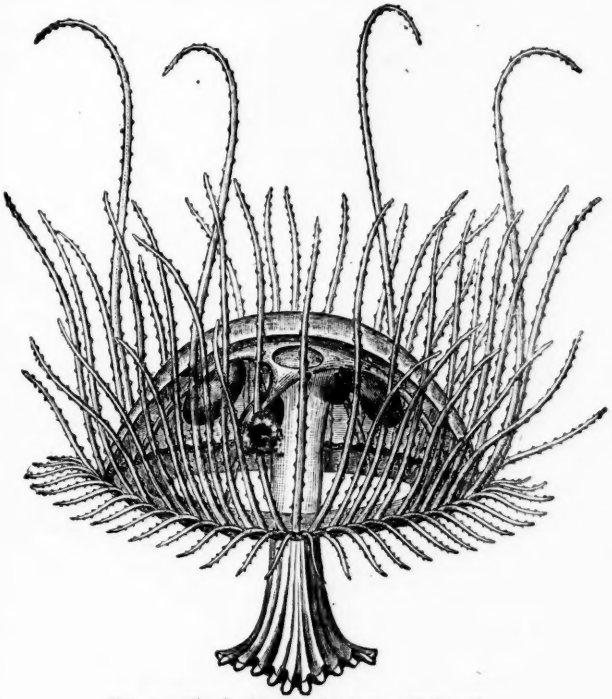

FIG. 5.—The fresh-water Medusa. Enlarged.

of star-fishes. And here it may be said that at the time this portion was written the later discoveries as to the nature of the nervous system of crinoids had not been published. It is now known, by the experiments of Marshall and Jickeli, as well as the histological investigations of the two Carpenters, that the visible nerves in crinoids belong to a general subcutaneous nervous sheet.

The well-known movements of the star-fish are then described and well illustrated (Fig. 6), as well as the natural movements of

a brittle-star when proceeding along a solid horizontal surface (Fig. 7). All echinoderms when placed on their backs can right themselves, but different types have different ways of accomplishing this. The common star-fish does this by means of its

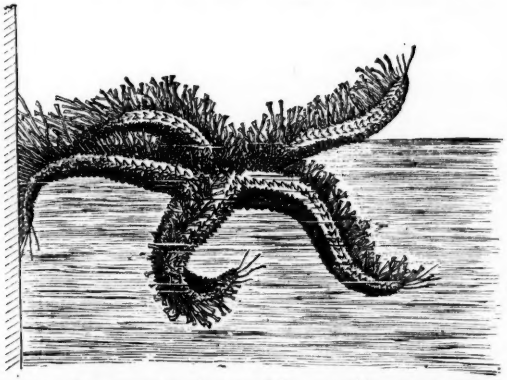

FIG. 6.—Natural movements of a star-fish on reaching the surface of water.

suckers (Fig. 8) in half a minute. The Astropecten rights itself in the way here figured (Fig. 9). It stands on the tips of four of its rays, while the fifth one is thrown upwards and over the others, in order to carry with it the two adjacent rays, "and so eventually to overbalance the system round the fulcrum supplied by the

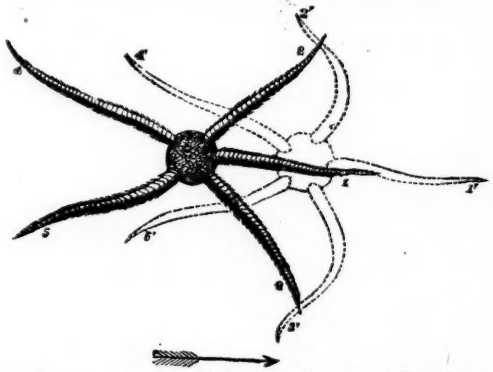

FIG. 7.—Natural movements of a brittle-star when proceeding along a solid horizontal surface.

tips of the other two rays, and thus bring the animal down upon its ventral surface."

Such movements are more difficult to perform in the sea-urchins, and only fresh and vigorous specimens can right them-

selves at all, owing to the heavy round body and feebler suckers. Fig. 10 represents one on its back with as many feet as possible

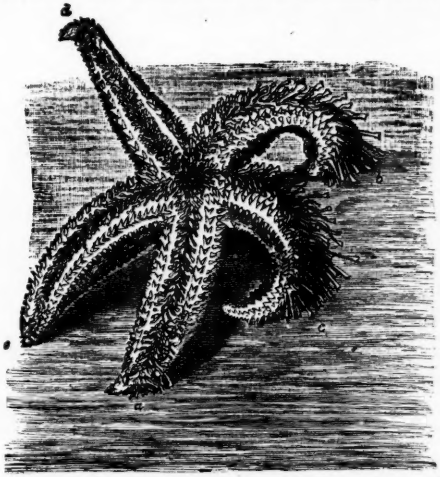

FIG. 8.—Natural righting movements of the common star-fish.

protruded downwards and fastened firmly to the floor, "their combined action then serves to tilt the globe slightly over in their own direction, the anchoring feet on the other or opposite

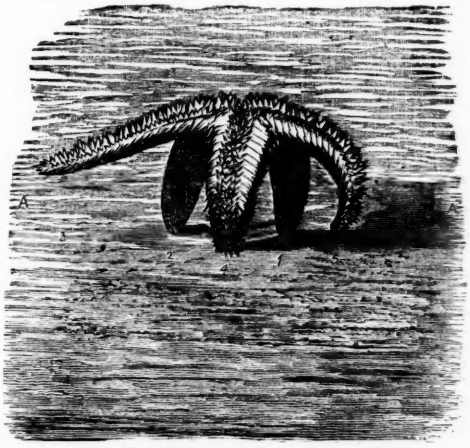

FIG. 9.—Righting movements of Astropecten.

rows meanwhile releasing their hold of the tank to admit of this tilting. The effect of this tilting is to enable the next feet in the

active ambulacral rows to touch the floor of the tank, and when they have established their hold they assist in increasing the tilt; then the next feet in the series lay hold, and so on till the globe slowly but steadily rises upon its equator." Finally it lets itself

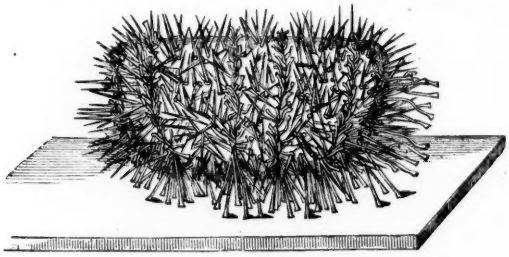

FIG. 10.—Echinus beginning to right itself.

down very slowly and carefully, the feet on one side preventing its too rapid descent (Fig. 11).

Experiments on stimulation were made with the result of proving that the feet, spines and pedicellariæ are all highly coördinated in their action. Taking all the facts of stimulation together, it seemed probable that all these organs are "held in communication with one another by means of an external nervous plexus." Accordingly the author and Professor Ewarts went to work to see if they could obtain any microscopical evi-

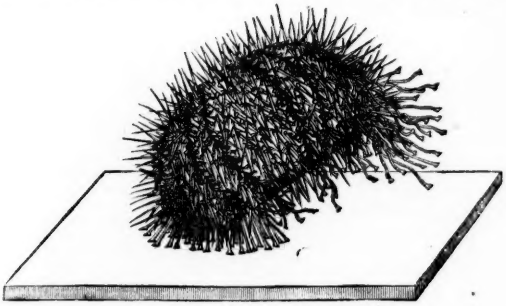

FIG. 11.—Echinus nearly righted.

dence of such a plexus. This they succeeded in doing, and afterwards found that Professor Lòven had already briefly mentioned such a plexus as having been observed by him. The plexus consists of cells and fibers closely distributed all over the surface of the shell, immediately under the epidermal layer of cells (Figs. 12, 13), and it sends fibers all the way up the feet, spines and pedicellariæ. This important discovery led to further experiments on sections. It appears that single rays, when cut off from the body, crawl as fast and in as determinate a direc-

tion as do the entire animals. They also crawl up perpendicular surfaces, and sometimes away from injuries, though not generally seeking to escape the latter as do the entire animals. By severing the nerves at the base of each of the five rays, or by dividing the nerve-ring between all the rays, the animal loses all power of coördination among its rays (Figs. 14, 15). If a continuous circular section of the external surface of the sea-urchin was made, it was invariably found that the spines and pedicellariæ within

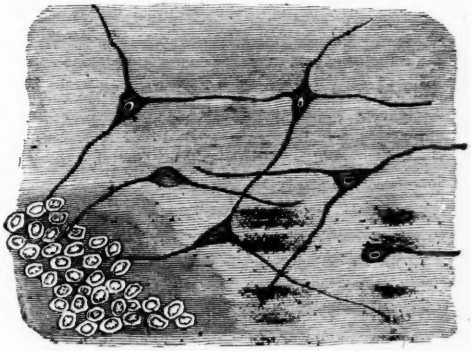

FIG. 12.—External nerve-plexus of Echinus.

the circular area immediately respond to stimulation, while none outside the circle are affected. "These facts prove that the function which is manifested by these appendages of localizing and gathering round a seat of stimulation, is exclusively dependent upon the external nerve-plexus." From these and other experiments, and the histological studies of Professor Ewarts, it is concluded that the nervous system of an Echinus consists (1) of an

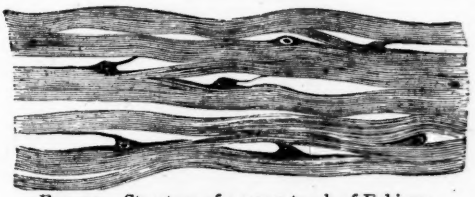

FIG. 13.—Structure of a nerve-trunk of Echinus.

external plexus which serves to unite all the feet, spines and pedicellariæ together, so that they all approximate a point of irritation situated anywhere in that plexus; (2) of an internal nervous plexus which is everywhere in communication through the thickness of the shell with the external, and the function of which is that of bringing the feet, spines and probably also the pedicellariæ into relation with the great coördinating nerve-center situated round the mouth; (3) of central nervous matter which is

mainly gathered round the mouth, and there presides exclusively over the coördinated action of the spines, and in large part also over the coördinated action of the feet, but which is further in part distributed along the courses of the main nerve-trunks, and

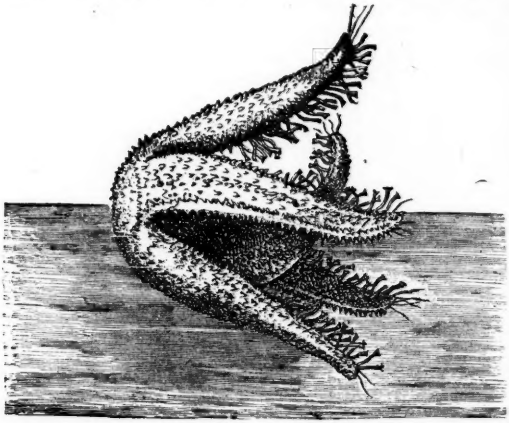

FIG. 14.—Uncoördinated movements of a star-fish in which the nerves of all the rays have been divided.

so secures coördination of feet even in separated segments of the animal.

It was also determined that the so-called eyes of star-fish and

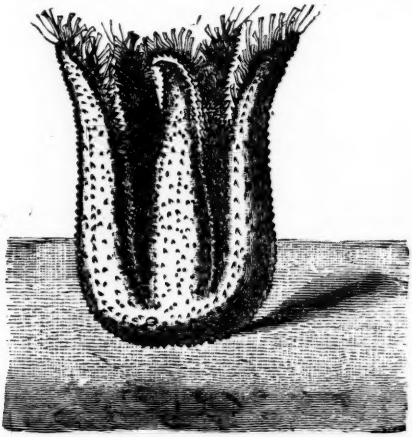

FIG. 15.—Posture frequently assumed when treated as in Fig. 14.

sea-urchins were really such, as if a large tank be completely darkened except at one end where a narrow slit of light is admit-

ted, and a number of star-fish and Echini be scattered over the floor of the tank, in a few hours almost the whole number will be found congregated in the narrow slit of light.

"On removing with a pointed scalpel the eye-spots from a number of star-fish and Echini without otherwise injuring the animals, the latter no longer crawled towards the light, even though this were admitted to the tank in abundance, but they crawled promiscuously in all directions. On the other hand, if only one out of the five eye-spots were left intact, the animals crawled towards the light as before. It may be added that single detached rays of star-fish and fifth-part segments of Echini crawl towards the light in the same manner as entire animals, provided, of course, that the eye-spot is not injured."

Finally, the presence of a sense of smell in star-fish which had been kept fasting for several days, was proved by presenting them with small pieces of shell fish. They immediately crawled to the food, and "if a small piece of the food were held in a pair of forceps and gently withdrawn as the star-fish approached it, the animal could be led about the floor of the tank in any direction." By progressively cutting off the rays and other experiments, it was found that the olfactory sense was equally distributed throughout their length, but along the lower surface.

These researches are certainly of much interest, and are positive additions to our knowledge of the nervous system and of the physiology of these types of life.

JORDAN'S CATALOGUE OF FISHES OF NORTH AMERICA.[1]—This catalogue will be a *sine qua non* of the ichthyologist. It is not only an index to the subject, but a good illustration of a generally rational nomenclature. The number of species now known is 1683. This number will be increased to a moderate extent from fresh and coast waters, and to a greater degree from deep-sea explorations. Thus the take of the Fish Commission steamer *Albatross*, for the past season includes seventy-five species which are not yet described.

Professor Jordan's efforts to do justice to honest work have been in the main successful. While employing such of the names of Rafinesque as are accompanied by recognizable indications; others formerly adopted are rejected, as resting on no sufficient evidence. We think, however, that in a few instances the author has gone a little further in favorable consideration of slip-shod work than justice to good work demands. Thus he adopts the two names Hypsoblennius and Reinhardtius, which were proposed without diagnosis or explanation, in preference to Isesthes and Platysomatichthys, which were defined when proposed. Professor Jordan has not previously taken this position, and he now informs

[1] *Catalogue of the Fishes known to inhabit the waters of North America north of the Tropic of Cancer.* By D. S. JORDAN (Extracted from the Annual Report of the Commissioner of Fish and Fisheries for 1884). 1885, p. 185.

us that it is opposed to his preferences and convictions, as it is to all the rules of nomenclature in existence.

A characteristic which it would be well for American naturalists to imitate, is the classical form and derivation of most of Professor Jordan's names. They display a refreshing contrast to the poverty of invention and barbarous constitution of the handiwork of too many of our countrymen of earlier years. Moreover we do not find the extravagant use of personal names, which has so prevailed of recent years in England and France. The dedication of a species to men of desert, still remains a compliment in this country, whatever it may have become elsewhere.

We append the following special notes apropos of one which appeared in the NATURALIST for 1885, page 814. In this note we did unintentional injustice to Mr. Meek in criticising determinations which we are informed, were mostly made by Professor Jordan. With regard to the *Pantosteus platyrhynchus*, whose characters were said to be due to "shriveling" of the specimen, our objections were well taken; as Professor Jordan informs us that this word is due to a slip of memory, and should be replaced by "soft and limp," the words used in his private notes. Further, Professor Jordan states that he cannot find barbels in either *Meda fulgida* Gir. or *M. argentissima* Cope, as I have described them in the latter, and as Girard failed to observe in the former. The former is very abundant in the San Francisco river, one of the heads of the Gila in New Mexico, where it is the small minnow of the stream. Like Jordan, I find no barbel in any specimen. I have reason to suspect the correctness of the locality given me as that of the *M. argentissima, i. e.*, the head waters of the Rio Grande. I suspect it comes from the waters of the Great Colorado. The locality given me for the *Pantosteus guzmaniensis* (*virescens*), "Arkansas river," I have long suspected to be erroneous. I have now reason to believe that it comes from the head waters of the San Juan river, a branch of the Colorado.

Professor Jordan adopts very properly Gill's new order of Lyomeri, for the remarkable Eurypharyngidæ.—*E. D. C.*

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## GENERAL NOTES.

### GEOGRAPHY AND TRAVELS.[1]

ASIA AND OCEANICA.—*The Badghis.*—The September issue of the Proceedings of the Royal Geographical Society contains a map of the territory about the Heri-rud and Murghab rivers, including the Badghis, which is the district the possession of which is now in dispute between Russia on the one hand, and Afghanistan and England on the other. The country was once well-peopled, but the raids of the Turkoman have made it a desert. Names on the map mark sites, not towns; ruins of forts, caravansaries, houses, or tanks, with only tombstones left to give the history. Most of the streams have two names, one Arab or Persian, the other Turkoman. Along the northern base of the Koh-i-Baba or Paropamisus are a succession of fertile valleys, formerly used for irrigation. Channels and subterranean canals or karezes remain to tell of past cultivation. The streams become salt

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

so soon as they touch a salt deposit which crops up ten to fifteen miles from the range.

Kustik, in a valley about fourteen miles long and three-fourths of a mile wide, is a Jamshidi town; but twenty miles to the east of it commences the Hazara country, a vast plain stretching toward the north, and eroded into a chaos of steep hillocks and hollows by the Murghab drainage. Kala-nau, the chief town of the Hazaras, is a prosperous one. The soil of the Hazara country is excellent—only the manual labor is needed. The Hazaras have enormous flocks of sheep and cattle.

As far back as the earliest periods of Arabic history, Badghis has been connected with Herat. It comprises the land watered by the Murghab and its tributaries. Its principal valley is Penjdeh. The Afghan forts of Bala Murghab and Meruchak are the only modern buildings north of the debouch of the river from the gorge in the Tirband-i-Turkistan, for the Jamshidi and Saryk Turkoman population live entirely in kibiskas or felt tents.

About twenty-eight years ago the Saryks, driven from Merv by the Tekkes, received the sanction of the Jamshidi chief, and located themselves at Penjdeh. These Saryks were once, together with Tekke, Salar and other Turkomans, the scourge of northern Persia, but since Russia has closed the slave marts, they seek for a stable government, and are giving their attention to agriculture. The Saryks own nearly 200,000 sheep.

North of the Badghis, a tract of country between the Murghab and the Heri-rud is called Chol, which is simply Turkoman for a desert that is not a sand desert. The light soil bears short grass almost everywhere until the dry season, and where there is less grass there are usually more bushes, the latter marking a more sandy soil.

The salt lakes of Yar-oilan are situated in depressions, the western one about 950 feet below the surrounding country, and 1430 feet above sea-level, while the eastern one is about 800 feet above sea-level. The beds of these lakes are a mass of hard salt, covered with a very little water. The western lake is the source from which the Tekkes get their salt, while the Saryks use the eastern lake.

In the discussion which followed the reading of Sir Peter Lumsden's paper, Sir Hy. Rawlinson gave his reasons for the identification of Meruchak with the upper Merv or Merv-el-Rud, said to have been founded in the fifth century by Kesra Anushirwan. The larger Merv, now in Russian possession, Balkh and Herat are the three oldest cities of Aryan civilization. The Paropamisus of the Greeks extended no further westward than Herat, the westward continuation being called Sariphe.

At Penjdeh, in a sandstone cliff 200 feet above the river, are some artificial caves, evidently once inhabited. The largest has a central passage 150 feet long, nine wide, and nine high to the top

of the vaulted ceiling. Doorways on each side lead to rooms fifteen to nineteen feet long, and of the same width and height as the passage. Doors were once placed in the entrances, as is proved by the holes for the fastenings. Narrow staircases lead to upper rooms, probably store rooms. Places for lamps remain, and there are traces of soot, but no carvings or inscriptions exist. Many other similar but smaller caves are found all along the valley.

*The Carolines.*—The Caroline islands were first discovered by a Portuguese navigator in 1526, and during the rest of the sixteenth century were frequently visited by Spanish and Portuguese explorers. They were first named the Carolines by a pilot named Lezcano, about 1686, in honor of Charles II of Spain. Towards the end of the seventeenth century the Spaniards in the Philippines and Mariannes learned something about the Carolines, and an imperfect map of the group was sent to Pope Clement XI in 1705. In 1710 the Jesuits of Manila sent missionaries there, but these, with a few soldiers who accompanied them, were massacred at the Pelews. Though navigators of all nations visited these islands, their number and exact position, as well as the hydrography of the seas in which they were situated, remained unknown until 1817, when they were visited by Kotzebue. After him came Freycinet in 1819, Duperrez in 1824, Dumont d' Urville in 1826, and others, and from these came the first accurate accounts. The group, situated west of the Marshalls, and north of New Guinea, contains about 500 islands, most of which are atolls. The number of real islands is only forty-eight, but as each has a certain number of islets around it, there may be said to be forty-eight groups; forty-three of these are low coral islands, while five are basalt with coral at the base. There are three main groups, separated by two large channels; the principal island of the eastern group is Ponape or Ascension, that of the western Eap, Jap or Yap. Ponape is sixty miles round and has in its centre a peak 2860 feet high. Upon it are some curious ruins, apparently the remains of a large building made of blocks of basalt. There are two rainy seasons, January and August, and the climate is comparatively temperate. The population is from 18,000 to 20,000. The principal elements are Malay and Maori, but there is also a mixture of Negrito and Papuan, and in later times a Japanese and Chinese element was added. The language is also mixed. In some islands there are two languages—the vulgar and the polished. *Tabu* is practised. Each group of islands has its chief, whose power in time of peace is nominal, but in time of war is unbounded.

The Pelews, the most western isles of Micronesia, about 600 miles east of the Philippines, are a group of ten principal islands and a number of islets. The largest island, Babelthuap, is about thirty miles long. All the islands are covered with thick forests. The population is about 3500, and is probably the result of a

mixture of Malays with an inferior race of aborigines. The king has instituted an order, the insignia of which is the first cervical vertebra of a dugong.

An interesting account of these islands will be found in the "Animal Life" of Semper, who spent some time upon them.

M. E. Planchut, in a recent issue of the *Revue Scientifique*, states that the people of the Carolines are in continual relations with those of the Mariannes, which undoubtedly belong to Spain, that the Caroline natives are treated as compatriots when cast upon the Philippines, and that in the eyes of a Spaniard the partition made by Alexander IV is still in force. The entire area of the Carolines, Ualam, Panope, and Kong excepted, would not cover more than 200 miles in length by 200 meters in width. Thus the population is about 500 to the square mile. The same writer states that the people believe in a supreme being, whom they call Machi-machi. Their temples are pyramidal huts with a rough-hewn stone in front, and it is believed that were this stone to be raised by a chief who wished to chastize a mutinous people, the earth would tremble and the sea leave its bed to drown the rebels. M. Planchut states that the Palaos or Pelews have only 1200 inhabitants.

*Corea.*—Beyond the granite mountains which surround Siril, Mr. Carles has come upon extensive lava sheets covering a large portion of Corea. "There are three great oval fields of lava passing almost in a straight line through the mountain chain which runs from the north to the south of Corea, at a height of about 1500 feet above the sea near the divide, and of 500 feet on the lower levels. There is also another plain about four miles wide and twelve miles long to the east of the Kaun-Sŏng district, the direction of which is not so well defined; but in which the depth of lava is apparently greater than that in the others." No crater is visible to account for the enormous mass of lava, which must have welled up from extensive fissures.

*Asiatic and Oceanic News.*—Mr. Gardner, British Consul of Newchwang, estimates the population of Manchuria at 15,000,000. Its three provinces are Heh-lung-Kiang, Kirin, and Fêngtien. The port of Newchwang was opened to trade in 1861.——The Sakeis of Selangore, in the Malay peninsula, seem to have no form of religious worship, but believe in omens. They kill small game with a blow-pipe and dart poisoned with Upas-juice, and large game with a kind of cross-bow formed of a bamboo spear placed in a grooved log, and a bent sapling held back by a rattan cord. This is stretched across a path in the woods. The Sakeis live in bamboo huts thatched with palm-leaves. They are a shy, harmless people, similar in appearance to the Malays, but smaller in statue and with wavy hair.——The Geographical Society of Hamburg, in a recent publication, gives the area of Kaiser Wilhelm's Land or German New Guinea at 34,508 square miles.

The other German annexations in the Pacific are New Ireland, 3398.8 square miles, New Britain, 9348.8 square miles, and the Bismarck archipelago 15,261.6 square miles, in all about 65,512 English geographical square miles. The same authority gives the area of the British annexations in New Guinea at 65,517.76 square miles. Each country has thus annexed a territory about twice the size of Ireland.——Arminius Vambery contributes to the September issue of the Proc. Roy. Geog. Society a list of the names of towns, rivers, etc., in the disputed country between Merv and Herat.——Russian geographical exploration of the Caucasus has begun. MM. Iljin and Dimick have traveled among its glaciers, climbed its passes and given an account of their travels in Petermann's Mittheilungen. Ushba is estimated at 16,500 feet, Tetuuld at 15,500 or thereabouts. The Swanetians, to whose brutality Russian officers fell victims a few years ago, are now quiet. M. Dimick has explored the glaciers of Elbruz. From the resumé of these explorations given by D. W. Freshfield, it does not appear that they add greatly to the work done by Mr. Grove, Captain Telfer, Mr. Phillips-Wolley and Mr. Freshfield.

AFRICA.—*African News.*—Notwithstanding the comparative failure of M. Giraud's expedition, he has added much to our knowledge of Lake Bangweolo and its neighborhood. The form of the lake, as given by him, differs widely from that given by Livingstone, and the Luapula head of the Congo issues from its southern prolongation. M. Giraud has traced it as far as Lake Mœro or Mœro Mkata. It may yet be proven that the Lualuba, may be the true head-stream of the Congo, as, where it issues from Lake Upembe, it has, according to Herr Reichard, a width of 1000 to 1500 feet.——Mr. Grenfell reports that Tippo Tib, the well-known Arab slaver, is evidently preparing for a permanent occupation of Stanley falls. He is making large plantations and is expecting 2000 more men.——From the collections made by M. Humblot during a stay of several months on Great Comoro, it appears that no indigenous mammal is found there. Thirty-four species of birds were found. After an examination of the collections MM. Milne-Edwards and Oustalet came to the conclusion that the fauna has no relation with that of Madagascar, but has been imported from neighboring regions.

AMERICA.—*American News*—Mr. Glaisher has ascended the Berbice river and Wieroonie creek from Georgetown. The banks are thickly populated. After passing some islands the river opens out into wide lake-like expanses of water, the land becoming high. Above the first rapids Mr. Glaisher left the river for its tributary, the Wieroonie creek, which he ascended to within a day's journey of the Demarara river.——M. Violet d' Aouest has discovered in Mexico, on the flanks of the most elevated mountains, argilla-

ceous deposits which could not be attributed to decomposition of the rocks in situ, or to the alluvium deposited by the rivers, or to rain. He attributed them to atmospheric currents. The winds by day raise the particles from the plains, and carry them at night to the hills.

EUROPE.—*European News.*—Sulitjelma, in 67¼° north latitude, and belonging as much to Norway as to Sweden, has hitherto been believed to be the highest Swedish mountain. Last year the topographical surveyor of Norrland found that Sarjekjakko, in Swedish Lapland, is quite 1000 feet higher than Sulitjelma, that is, about 7000 feet. Dr. Svenonius now states that Kebnekaisse, also in Lapland, has been ascertained to be 7300 feet above sea-level.——The rocky islet Munken, three and a half miles south of Sumbö, has completely subsided. The rock is well-known in history. It is mentioned in 1673 by Pastor Lucas Jacobson Debes, and plays a conspicuous part in geographical literature, especially with reference to the Zeni narrative. The islet was formerly seventy feet high, but is now no higher than the surrounding rocks, so that the sea covers it even in fine weather. The shoals around are dangerous, and will now be more so. In 1800 the rock was described as like a ship under full sail when seen from seaward, while from the land it resembled the figure of a monk.

## GEOLOGY AND PALÆONTOLOGY.

POLEMICS IN PALÆONTOLOGY.—The present activity in vertebrate palæontology is accompanied by considerable controversy in various directions. M. Lemoine and M. L. Dollo are at issue regarding the identity or non-identity of the genus Champsosaurus Cope and Simœdosaurus Gervais; M. Dollo maintaining their identity and referring to the Champsosaurus, a skeleton found at Erquelines. M. Lemoine states that the Erquelines example comes from an horizon different from that which yielded Simœdosaurus, and that, in order to force an identification, M. Dollo has accused him (M. Lemoine) of errors which he did not commit. On the identity of the American and Cernaysien forms M. Lemoine reserves his opinion. M. Dollo answers by asserting the identity of horizon of the French and Belgian specimens, and giving reasons for considering the remains as belonging to the same species. Passing in review the cranium, atlas and axis, vertebræ, scapula and coracoid, and other parts, he not only denies the existence of any proved divergence between the American, Cernaysien and Belgian examples, but declares that the bones described by M. Lemoine as scapula and coracoid are really not those bones, since they are shown as placed one over the other, whereas there is a true articulation between the actual scapula and the coracoid. He suggests that the scapula of M. Lemoine may be a part of the coracoid.

Dr. Schlosser, of Munich, endeavors to show that Dr. Lydekker is in error in proposing, in the catalogue of the vertebrate fossils in the British Museum, to combine certain species of Rodentia, described by him in his monograph of the Tertiary Rodentia of Europe.

Dr. Lydekker, in the London *Geological Magazine*, reviews the illustrated papers published by Professor Cope in the AMERICAN NATURALIST on American fossil Vertebrata. He differs generally with the systematic views of Professor Cope, and diverges even more from him in his nomenclature. This paper will be answered by Professor Cope. Dr. Lydekker affirms the identity of Hyopsodus Leidy with Microchœrus Wood; and of Esthonyx Cope with Miolophus Owen. Professor Cope, in a note to the *Geological Magazine*, shows that there is not sufficient ground for the latter identification.

Dr. Baur believes that the bone in Iguanodon supposed by Marsh to be clavicle, is really sternum, as indicated by Dollo.

THE ANKLE AND SKIN OF THE DINOSAUR, DICLONIUS MIRABILIS.—The fibula of this saurian lies at its distal end in a groove of the external part of the front of the tibia. It is compressed so as to be anteroposterior. It terminates in an epiphysis-like calcaneum. The astragalus has the usual form, and embraces the tibia closely. Its anterior ascending process is rather short and thin. Posteriorly the tibia rests on the astragalus and is not overlapped by it. A portion of the extremity descends and fills an angular space which enters between the astragalus and calcaneum behind, and takes part in the ankle-joint. This does not occur in the *Ornithotarsus immanis*.

A portion of the integument from the pelvic region of this dinosaurian is preserved. It is indicated by a thin brown layer like the remains of corneous teeth, which I have described as existing in the premaxillary region.[1] It is in the form of small sub-pentagonal disk-like scales, each with a beveled and coarsely crenate margin. They do not fit closely except at the interior or basal part of their edges. The scales resemble considerably the divisions of the skin of *Rhinocerus sondaicus*. The scales are about a centimeter in diameter.—*E. D. Cope.*

PLIOCENE HORSES OF SOUTHWESTERN TEXAS.—The pliocene beds of Southwestern Texas have yielded several interesting species of Mammalia. Among these may be mentioned *Mastodon americanus* Cuv. and *M. serridens* Cope,[2] and *Cistudo marnockii* Cope. But horses of the genus Equus are the most numerous in species and individuals. The following identifications are based on specimens received from Messrs. Wm. Taylor and G. W. Marnock, to whom I hereby express my acknowledgments.

[1] Proceedings Academy Philadelphia, 1883, p. 104.

[2] NATURALIST, 1884, p. 525.

Library of
Miami University.

PLATE XXXVII.

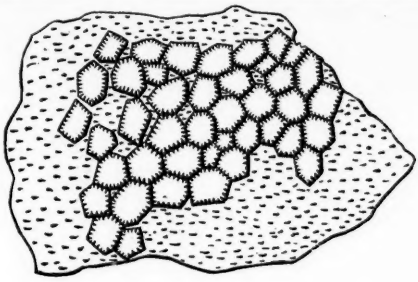


Fig. 1.

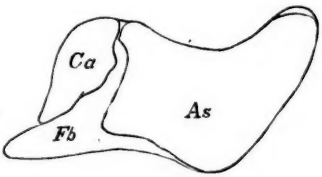



Fig. 2.

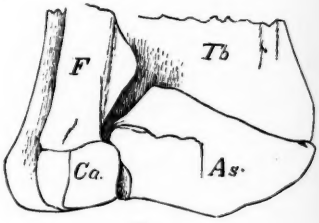



Fig. 3.

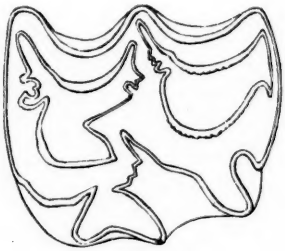


Fig. 4.

Fig. 5.

Fig. 6.

FIG. 1.—Portion of the skin of *Diclonius mirabilis*, three-fourths natural size. FIGS. 2, 3.—Extremity of fibula and tibio-tarsus of do., one-seventh nat. size; 2 from below, 3 from front; *Tb*, tibia; *F*, fibula; *As*, astragalus; *Ca*, calcaneum. FIG. 4.—*Equus crenidens?* Cope: grinding face of superior molar tooth, nat. size. FIG. 5.—Superior molar tooth of right side of *Hippotherium peninsulatum* Cope; grinding surface from below, natural size. FIG. 6.—The same of *Protohippus castilli* Cope; same view, natural size.

EQUUS BARCENAEI Cope. Proceeds. Amer. Philos. Society, 1884, pp. 10–15. One superior molar. Hitherto only known from the valley of Mexico. From Mr. Marnock.

EQUUS FRATERNUS Leidy, 1858. *E. tau* and? *conversidens* Owen, 1869. From Mr. Marnock.

EQUUS EXCELSUS Leidy. Approaches the last named species. From Mr. Taylor.

EQUUS OCCIDENTALIS Leidy. The most southern and eastern locality for this species, which has not hitherto been found away from California and the Great Basin. One very characteristic superior molar, from Mr. Taylor.

EQUUS? CRENIDENS Cope. Proceedings Amer. Philosoph. Society, 1884, p. 10–12.

This or a nearly allied species is represented by a single, and the largest, superior molar tooth of a horse which I have seen or find recorded. The measurements exceed those of the typical *E. crenidens* (which has not, so far, been found out of the Valley of Mexico), and there are some other differences in the distribution of the enamel-folds. It is distinguished from the other species of Equus by the small diameters and concaved inner border of the anterior internal column, by the simplicity of the enamel-folds, and the crenate character of the margins of the lakes, together with the large dimensions. The crenation is less obvious in some specimens than in others, and in the one here noticed is almost confined to the borders of the posterior lake. The diameters of the crown measure: anteroposterior, $41^{mm}$; transverse, $37^{mm}$; length, $120^{mm}$.

Fig. 4, Plate XXXVII, represents the grinding face in outline.

Of the five species of Equus of Southwestern Texas, four have been found in the pliocene of the Valley of Mexico, and one is peculiar to the Pacific coast and basin of North America. Of the characteristic species of the Eastern United States, *E. fraternus* and *E. major*, the former only has been found. (For comparison I introduce Figs. 5 and 6, Pl. XXXVII, of three toed horses from the Loup Fork bed of Mexico. See Proceeds. Amer. Philos. Soc., Oct., 1885.)—*E. D. Cope.*

LIST OF THE GEOLOGICAL FORMATIONS OF SPITZBERGEN.[1]—*Quaternary system.*—Beds of sand and clay with remains of terrestrial plants, marine shells and weeds (some species not living at present on Spitzbergen, *e. gr.*, *Littorina littorea*, *Mytilus edulis*, and *Fucus canaliculatus*), "Blomstrand's beds," "beds of the Reindeer valley," etc.

*Miocene system.*—Sandstones, schists, etc., at King's bay, Cape Staratschin, Cape Heer, Heer's mount, Cape Lyell, Scott's glacier, with more than 200 sp. of fossil plants, *e. gr.*, Equisetum, Sequoia, Taxodium, Glyptostrobus, Pinus, Acorus, Iris, Acer, Platanus, Tilia, Corylus, Populus, Grevia, Hedera, etc.

*Cretaceous system.*—Sandstone at "the Fastness" (ice fiord)

[1] According to Osw. Heer's Flora Fossilis Arctica, and the discoveries of the Swedish expeditions by O. Torell, A. E. Nordenskiöld, C. W. Blomstrand, A. Nathorst, P. Oberg and G. Nauckhoff.

with about twenty sp. fossil plants, among which *Sequoia reichenbachii.*

*Jurassic system.*—1. Upper beds: The beds at Cape Boheman with fossil plants, *e. gr.*, *Ginko digitata*, Pinus, Podozamites, Scleropteris, etc. 2. Lower beds: The marine beds of Cape Staratschin, Green harbor, Advent bay, Sassen bay, Cape Agardh, with Ammonites, Belemnites, Cardium, Leda, Inoceramus, Aucella, Pecten, Ophiura, etc.

*Triassic system.*—Bituminous limestones and schists of Cape Thordsen, Saurie hook, Cape Staratschin, Cape Lee, Whales point, with bones of Reptilia, *e. gr.*, Ichthyosaurus, Acrodus, etc.; and Mollusca, *e. gr.*, Ammonites, Ceratites, Daonella, Halobia, Pecten, Lingula, etc., and with beds of phosphates of lime.

*Carboniferous system.*—1. Upper beds: Sandstones, schists, etc., at Recherche bay, with vegetable fossils, *e. gr.*, Lepidodendron, Lepidostrobus, Stigmaria, Cordaites, Rhabdocarpus, Adiantites, Sphenopteris, etc. 2. Calcareous beds with Productus, Spirifer, Rhynchonella, Chonetes, Euomphalus, etc.; limestones, sandstones, schists, gypsum and silex of Beeren island, South cape, Horn sound, Bell sound, Ice fjord, King's bay, Henloopen strait, Stansforeland, etc. 3. Lower beds ("palæanthracitic beds," "ursastuffe"): Schists, sandstones and coals of Beeren eiland, Klaas Billen bay and Bell sound, with Lepidodendron, Stigmaria, Calamites, Cyclostigma, Knorria, Cardiopteris.

*Devonian system?* ("The Liefde bay formation").—Green and red schists, red sandstones and limestones at Liefde bay, Wijde bay, Dickson bay, Klaas Billen bay and Beeren eiland, with indeterminable fish-scales and bivalves.

*Silurian system?* ("The Hecla Hook formation").—Quartzites, dolomites and black schists from different localities, and containing indeterminable bivalves. The whole western part of Spitzbergen and the Northeastland.

*Primitive system.* — Gneiss, mica schists, quartzites, marbles, dioritic schists, granites, etc, of the N. E. part of Spitzbergen, North cape, Seven islands, etc.—*J. Lindahl.*

GEOLOGICAL NEWS.—*General.*— G. F. Becker (*Amer. Journ. of Science*, Sept., 1884) has a note upon the relations of the mineral belts of the Pacific slope to the great upheavals. A great majority of all the profitable ore deposits west of the crest of the Wasatch occur in belts a few miles in width which follow the western edges of distinct geological areas. Thus the lead-silver belt of Utah follows the Cretaceous, the belts of Nevada and Arizona the Palæozoic, and usually the Carboniferous; the gold belt of Eastern California the Jura-trias, and the quicksilver belt of Eastern California the Tertiary.——*Psyche* contains a contribution to the geological history of myriopods and arachnids, by S. H. Scudder. The group Archipolypoda resemble the Diplopoda in having two pairs of legs on every segment; while in the Proto-

sygnatha only a single pair of legs is borne by each segment, and the group thus resembles the Chilopoda. For a brief period after leaving the egg, modern diplopods and pauropods have a shorter body than in after life, and the first three segments bear but a single pair of legs. In adult life these first three segments still bear but a single pair of limbs, while all the other segments, both those which exist in the larval state and those which develop afterwards, bear two pairs. The Chilopoda have these same three anterior pairs of limbs early and permanently developed as organs of manducation, while all other segments have but a single pair. Palæontological evidence is in favor of the view that the dorsal scutes of Diplopoda are compound. The archipolypodous type is the oldest, and there is evidence that some of the Carboniferous forms were amphibious. The group culminated in the Carboniferous, and does not appear to occur later than the Dyas, while, with one doubtful exception, no true diplopod is known to be older than the Oligocene.——According to S. H. Scudder between twenty and thirty species of pre-Tertiary Arachnida are now known, and the earlier forms, chiefly of Carboniferous age, belong either to the scorpionides or to the Anthracomarti, a group which is not known later than Palæozoic times, the only Mesozoic arachnids yet known being true spiders. In the amber deposits of Prussia all the suborders of Arachnida occur except the Pedipalpi and the already extinct Anthracomarti.——Sr. G. B. Villa (Atti. d. Soc. di Sci. Nat.) gives a review of the rocks of Brianza (Italy) with a list of the principal fossils of each horizon from the Trias to the most recent strata.

*Mesozoic.*—Bulletin No. 19 of the U. S. Geological Survey consists of notes on the stratigraphy of California, by G. F. Becker. The metamorphic rocks of the coast ranges often show proof that plication was not effected by flexure but by innumerable fractures, the resulting small fragments being retained in their approximately original position by mutual pressure and afterwards re-cemented by silica. The Knoxville beds, the age of which is near the limits of the Jurassic and Cretaceous, are the youngest beds of the coast ranges which are known to have experienced the peculiar magnesian and siliceous metamorphism of these ranges. The overlying Chico beds are shown to be nonconformable with the Knoxville beds, and over wide areas the Chico, Tejon and Miocene strata seem to be perfectly conformable with each other. The upheaval and metamorphosis of the Knoxville strata is referred to the close of the period of their deposition. The auriferous beds of Mariposa are referred to the same horizon as the Knoxville beds. It is maintained that there has been a great east and west compression of the country, connected with the great faults in the Wasatch and the Sierra, while a land barrier existed in the position of the Sierras from a time prior to the Cretaceous onward, and accounts for the difference

in the faunas of the Pacific Coast waters and those eastward of them. The Sierras and Coast ranges are referred to a single mountain system.——A. D. Achiardi gives the particulars of an examination into the macroscopical and microscopical characters of the trachyte and quartziferous porphyry of Donoratice, near Pisa, Italy. The trachyte is covered, here and there only, with Eocene sediments which seem to have been disturbed by the eruption. The porphyry traverses the parti-colored schists of the Upper Lias and also the marbles of the Lower Lias, and is only about 400 meters distant from the trachyte, the space between being occupied by Eocene sediments. D'Achiardi finds the materials of these two rocks to be chemically the same, and the mineral species contained in them, for the most part, identical, but while the trachyte has cooled rapidly upon the surface of the rocks, the porphyry was intruded through them, and cooled slowly. The same mineralogist notes the presence in the Apuan Alps of tormalinolite.

*Tertiary.*—Mr. W. Whitaker, in a Note on the Red crag of Norfolk, Eng., states that the unfossiliferous sand upon the surface of the crag is identical with the sand of the shelly crag below, which has not been eroded by surface waters before the deposition of the upper beds, but dissolved by the action of carbonated water after the overlying beds were deposited.

*Glacial.*—Professor J. E. Todd (Proc. Amer. Assoc., 1884) describes the geology and geography of the Missouri coteau, which he states to be neither a high plateau nor a typical one. It is built mostly of Cretaceous clays of the St. Pierre group, capped northward with thin even layers of Fox Hills sandstone, and southward with Loup River sandstone. Two moraines are quite easily traceable upon it, and these, from their elevation, position and general features are probably equivalent to the Altamont and Gary moraines named by Professor T. C. Chamberlin on the Coteau des Prairies. The outer moraine is the more pronounced, consisting of loops, convex usually toward the west and south, but in rare cases toward the north-west. Traces of four great lobes of the ice-sheet, pushing through from the James to the Missouri, can be found.

## MINERALOGY AND PETROGRAPHY.[1]

METEORITES.—A number of very important contributions to the literature of these interesting bodies, which reach our globe directly from the regions of space, have recently been published. Papers relating to meteorites have heretofore been largely confined to detailed descriptions of particular falls. With the exception of Rose's essay on the classification of these bodies, little of a general nature regarding them has been produced until within the past year or two. Now, however, we have at least four

[1] Edited by Dr. GEO. H. WILLIAMS, of the Johns Hopkins Univ., Baltimore, Md.

extensive works dealing with their classification and the results of their microscopical and chemical study. These are, moreover, quite different in their aim and scope.

First may be mentioned Dr. M. E. Wadsworth's Lithological Studies,[1] the first part of which, published in October, 1884, contains much useful information regarding meteorites. The results of the microscopical study of thin sections of these bodies by many investigators, as well as by Dr. Wadsworth himself, are here brought together in convenient form. They are very properly classified with terrestrial rocks as a part of the same series, in which they also represent certain members more basic than any found in the earth's crust near its surface.

Probably the work which will do most to spread abroad just and accurate ideas of the exact nature and mineralogical composition of the meteorites, is the series of microphotographs recently published by Professor G. Tschermak, of Vienna.[2] There is scarcely any one to whom a richer collection of this rare material was accessible, nor any one better fitted by his own researches for successfully preparing such a volume. Thin sections, one hundred in number, illustrating every phase of structure and composition met with among meteoric stones, have been reproduced so admirably by photography as to afford the best possible substitute for the originals. When it is remembered how few can ever hope to thoroughly study sections of meteorites themselves under the microscope, the value of these photographs, which necessarily far exceed any possible descriptions, will be appreciated. Each plate is accompanied by a full explanatory text. The work was executed by J. Grimm, of Offenburg, who is already well known for his superb microphotographs of rock sections, edited by Professor E. Cohen. The same firm promises a similar set to illustrate the structure of meteoric irons, the appearance of which will be awaited with interest.

Professor Staislas Meunier, of Paris, has recently published an elaborate work entitled " Les Météorites."[3] In this he presents a new classification, as well as his views respecting the origin of these bodies. The latter agree with those of Reichenbach, Haidinger and Tschermak in considering meteorites, at least such as possess a breccia-like appearance, as aggregations of much smaller bodies of matter distributed through space, which have been brought together by their mutual attraction.

Another extremely important paper on meteorites is that by Dr. Aristides Brezina, curator of the royal mineralogical cabinet

[1] Memoirs Mus. Comp. Zool. at Harvard Col. Vol. XI, pt. I, Oct., 1884.

[2] Die mikroskopische Beschaffenheit der Meteoriten, erläutert durch photographische Abbildungen. Stuttgart, 1885.

[3] Les Météorites. Paris, 1884. Appendix to Vol. II of Fremy's Encyclopédie Chimique.

of Vienna.[1] This is ostensibly a report on the condition of the meteoric collection belonging to the cabinet, but really contains much matter of very general interest. Brezina can find nothing in the structure of the meteorites to indicate a secondary or conglomerate nature. He regards them as the product of a very rapid crystallization from a homogeneous magma. Respecting their origin, he considers the old theory of Chladni (1818) and von Hoff (1835) as the most probable. According to this the meteorites reach the external atmosphere of the earth as dust-like or gaseous agglomerations, which, by the sudden diminution of their cosmic velocity, are enormously heated and at the same time condensed into solid bodies. The classification adopted is in the main a petrographical one, following in the principal groups those of Rose and Tschermak. Many new subdivisions are, however, introduced to cover the results of the more thorough and elaborate study. The meteoritic collection in Vienna is the largest in the world, representing 358 localities, while that of London has 350 and that of Paris 300.

Short notices have recently appeared by Professor C. U. Shepard, on the Fomatlán, Jalisco, Mexico meteorite (which fell August, 1879), which is composed largely of olivine and octahedral crystals of nickeliferous iron;[2] also by the same writer on the meteoric iron of Trinity county, California.[3] Meteoric irons have also been described and analyzed by N. T. Lupton from Santa Rosa, Mexico;[4] by George F. Kunz, from Glorietta Mt., Santa Fé county,[5] New Mexico; and by R. B. Riggs, from Grand Rapids, Michigan.[6]

Mineralogical News.—All mineralogists will be glad to welcome the new and enlarged edition of Professor P. Groth's invaluable treatise on physical crystallography.[7] This work, which has done such good service ever since its appearance in 1876, has been partially rewritten and considerably extended, especially by its descriptions of all the newest methods and apparatus for mineralogical investigation.——The admirable text book of mineralogy by Professor G. Tschermak, published in 1884, has become so popular that a second enlarged edition of it has already appeared.[8]——Professor J. Hirschwald, of Berlin, has issued a systematic description of the mineral collection of the Royal Technical High School, which will be of service to all mineral-

[1] Die Meteoritensammlung des k. k. mineralogischen Hofkabinets in Wien am 1 Mai, 1885. Jahrbuch der k. k. Geol. Reichsanstalt, xxxv, p. 126, 1885.

[2] *Am. Jour. Science*, Aug., 1885.

[3] Ib., June, 1885.

[4] Ib., March, 1885.

[5] Ib., September, 1885.

[6] Ib., October, 1885.

[7] Physikalische Krystallographie. Zweite auflage. Leipzig, 1885.

[8] Lehrbuch der Mineralogie. 2te Auflage. Wien, 1885. pp. 598.

ogists and collectors.[1]——F. Rinne concludes that crystals of milarite, which are apparently hexagonal, were really so at the time of their formation, and that their molecular disturbance is due to a subsequent change of conditions, as is true in the case of leucite and boracite.[2]

PETROGRAPHICAL NEWS.—The second part of the second volume of Professor J. Roth's Allgemeine Chemische Geologie has just appeared. This treats of the younger eruptive rocks, and especially on account of the wonderful completeness of its literature references, will form, as do the other parts of the same work, a most valuable addition to the library of every working geologist and mineralogist.——A very concise elementary textbook of microscopical petrography has recently appeared, by Professor A. von Lasaulx, of Bonn.[3] In spite of its small size it brings the essential points of this rapidly developing science down to date, and is especially to be recommended for its full bibliography.——In his recent exhaustive optical study of the mineral leucite, Professor C. Klein, of Göttingen, describes in some detail a new and very complete mineralogical and petrographical microscope, which is constructed by the well-known firm of Voigt & Hochgesang, of Göttingen.[4] This instrument, of which a cut is given in their latest catalogue (1885), may be had for 800 marks ($200), and is undoubtedly the most satisfactory microscope in the market for the especial uses for which it is intended.——Fr. Becke, of the University of Czernowitz, contributes a paper on the twinning of rock-forming pyroxene and amphibole.[5] He finds in certain Hungarian pyroxene andesites that the bronzite crystals are frequently grouped in radiating groups, in accordance with three twinning laws, viz: twinning planes 1, $P\overline{\infty}$ (vom Rath); 2, $\frac{2}{3}P\overline{\infty}$, and 3, $\frac{4}{3}P\infty$. The first of these is the most common and corresponds very closely to the twinning law for augite, twinning plane P2. The frequently mentioned twins of augite and hornblende in rocks, with a composition—face apparently inclined to the vertical axis, the writer follows Mr. George F. Becker[6] in considering merely ordinary twins, parallel to $\infty P\overline{\infty}$, which are cut in the section parallel to some pyramidal face.——J. H. Kloss, of Karlsruhe, has made some interesting contributions to the subject of secondary hornblende in rocks.[7] He finds abundant evidence of compact as well as fibrous hornblende (uralite) originating from the paramorphosis of pyroxene, and can

[1] Das mineralogische Museum der Könl. tech. Hochschule. Berlin, 1885.

[2] Neues Jahrbuch für Min., etc., 1885. II, p. 1.

[3] Einführung in die Gesteinslehre: Ein Leitfaden für den akademischen Unterricht und zum Selktstudium. pp. 215. Breslau, 1885.

[4] Neues Jahrbuch für Min., etc., Beil. Bd. III, p. 540.

[5] Tschermak's. Min. und Petrog. Mitth., VII, 93. 1885.

[6] Geology of the Comstock Lode. Monographs U. S. G. S., Vol. III, p. 113, pl. IV, fig. 28.

[7] Neues Jahrbuch für Min., etc., 1885. II, p. 82. Versammlung deutscher Naturforscher und Ærtze in Strassburg. Sept. 18–23, 1885.

see no reason why a single, homogeneous individual of the former mineral should not replace one of the latter. He furthermore thinks that such secondary hornblende (which cannot be regarded as an alteration product in the common sense), should be used for purposes of rock classification, and suggests names as uralitite, uralite-diabase, uralite-gabbro, etc., to be employed, of course, only where the secondary nature of the hornblende was beyond doubt.——Professor C. R. Van Hise, of Madison, publishes an important paper on the secondary enlargement of hornblende fragments in clastic rocks[1] altogether analogous to those which he and Professor R. D. Irving have previously described as occurring in the case of quartz and feldspar.[2] In certain conglomerates of Northern Minnesota hornblende fragments have been enlarged by the deposition of their own substance from solution in such a manner that the crystallographic and optical orientation of the crystal is retained, and twinning lamellæ are even continued into the newly-formed portion.——Professor J. W. Judd, of London, continues his studies of the eruptive rocks of the West of Scotland, in an interesting paper on the Tertiary and older Peridotites.[3] Aside from the great interest attaching to these rocks from their being of Tertiary age, Professor Judd calls attention to their remarkable freshness as calculated to throw light upon the original form of the minerals of the more basic massive rocks. Many of these, like labradorite, olivine, hypersthene and diallage, are well known to often possess a peculiar luster on cleavage surfaces due to the presence of inclusions. These are generally regarded as original in their nature, but Professor Judd considers them as secondary. He thinks that at great depths, under the action of pressure, circulating waters would have such an increased solvent effect that in certain planes a portion of the crystalline substance would be dissolved, leaving cavities of regular shape, resembling in their nature the "etched figures" which are produced in crystalline planes by the action of certain reagents. Into these cavities, or negative crystals, foreign matter is infiltrated, thus producing the so-called inclusions of indeterminable microlites. This process is designated as "*schillerization.*"——Messrs. Hague and Iddings contribute a most important paper on the development of crystallization in the igneous rocks of Washoe, Nevada,[4] to which no justice can be done here. Their main point is the convincing evidence they adduce to show that one and the same eruptive mass may solidify in a glassy form at the surface, and with a holocrystalline structure—even a coarsely crystalline structure—at great depths. The two forms are connected by every transitional stage.

[1] *American Journal Sci.*, Sept., 1885.
[2] Bulletin of the U. S. Geol. Surv., No. 8.
[3] Quarterly Journal of the Geol. Soc., Aug., 1885.
[4] Bulletin U. S. Geological Survey, No. 17. Washington, 1885.

## BOTANY.[1]

THE GRASSES OF MAINE.—Under this title Professor Fernald, of the Maine State College, has brought out a neat pamphlet of seventy pages and forty plates. It is designed for the use of the author's students, as well as for the farmers of the State. In the introduction is given a general description of the structure of grasses, with a pretty complete list of the technical terms used in ordinary descriptive works, and a couple of pages on the composition of grasses. An analytical key precedes the descriptive portion of the book, the latter occupying about fifty pages. Common names and the pronunciation of the scientific names are given in every case. The descriptions are much simplified, and appear to be fairly accurate. Short notes upon their agricultural value follow each species. Eighty-one species belonging to thirty-eight genera are described, and of these forty-two species are figured in the plates borrowed from the department of agriculture at Washington.

THE SPECTRUM OF CHLOROPHYLL.—When a ray of white light which has passed through a coloring-matter, for instance, a solution of one of the coal-tar dyes, red wine, or a solution of chlorophyll, is examined by means of a spectroscope, certain dark bands, known as absorption-bands, are observed at definite places in its spectrum. For convenience in examining the spectra of small amounts of coloring matters, a direct vision spectroscope attached to the tube of a microscope is employed, and the coloring-matter in question is placed in a flat-walled bottle or a glass cell on the stage of the microscope. The ray of light which is reflected from the mirror under the stage passes first through the colored matter, next through the objective, and lastly through the prisms which compose the microspectroscopic attachment to the tube.

In order to compare the spectra of different substances, a second prism or set of prisms is often used, by which the spectrum of a second liquid can be projected by the side of that of the first. The spectra of chlorophyll solutions from two different sources can thus be at once compared. One of the combinations can also be employed to project the solar spectrum (unchanged by passing through any color whatever), and its constant lines (Fraunhofer's lines) can be used for the determination of position of the bands seen in the spectrum of the liquid by its side.

The spectra of many substances, among which chlorophyll occupies a prominent place, have absorption-bands of such constancy in position and appearance that they are justly regarded as characteristic. The spectrum of an alcoholic solution of chlorophyll has been shown to be essentially the same as that of the chlorophyll granule itself. In order, however, to obtain all

[1] Edited by PROFESSOR CHARLES E. BESSEY, Lincoln, Nebraska.

the absorption-bands characteristic of chlorophyll, it is necessary to examine successively solutions of different degrees of strength, some of the bands appearing only in dilute, and others only in strong solutions.—*G. L. Goodale, in Bot. Text-Book.*

THE TREATMENT OF SETS OF BOTANICAL SPECIMENS.—In this day, when so many sets of plants are distributed by the many collectors and elaborators of groups, it becomes a serious question what to do with them in the herbarium. A single set, or even a few sets may be kept in the original form and consulted in this way, but when one has to ransack a dozen or more fascicles, in as many different sets, in order to make a comparison of the species of a particular genus, the trouble is entirely too much for a busy man. One dislikes to tear up his sets of Ellis' North American Fungi, Thuemen's Mycotheca Universalis, Linhart's Ungarns Pilze, Wittrock and Nordstedt's Algæ aquæ dulcis exsiccatæ, Rabenhorst's Algæ Sachsens and Algæ Europas, etc., etc., but really the labor of running over the numerous fascicles makes any other course impracticable. In the herbarium of the University of Nebraska, all sets of plants, of whatever groups, are cut up and distributed. The labels in all cases are distinctive, indicating with certainty the set to which each specimen belongs, and its serial number. Any specimen can thus be as readily referred to as if it were retained in the original fascicle, while the ease of consultation and comparison is greatly enhanced.

BOTANICAL NOTES.—The botanical portion of the second annual report of the Wisconsin Agricultural Experiment Station, by Professor Trelease, is mainly devoted to the spot-disease of strawberry leaves (*Ramularia tulasnei*). Three figures serve to make the descriptions much more easily understood, although the text is admirably clear. A paper of this kind is worth more than scores of pages of so-called "experiments," which too often constitute the bulk of the reports from American experiment stations.——J. G. Baker's synopsis of the genus Selaginella, which has been running through the *Journal of Botany* for many months, is brought to a close in the October number. The whole number of species described is 312, of which 105 are here described for the first time.——B. M. Everhart, of West Chester, Pa., has compiled an alphabetical index to the species of the first fifteen centuries of Ellis' North American Fungi. It will prove of great service to all who have occasion to refer to Ellis' specimens. From it we find that there are in the fifteen centuries thus far published twenty-five species of Peronospora, eighty of Puccinia, twenty-eight of Uromyces, fourteen of Ustilago, forty-seven of Polyporus, eighty of Peziza, etc., etc.——Professor Beal has published in Bulletin No. 5, of the Michigan Agricultural College, the results of experiments made upon the vitality of seeds, from which it appears that of seeds enclosed in sand in bottles and

buried twenty inches below the surface of the soil, at the end of five years the following per cents grew, viz: Of *Amarantus retroflexus*, forty-two; *Ambrosia artemisiæfolia*, none; *Brassica nigra*, none; *Bromus secalinus*, none; *Capsella bursa-pastoris*, one hundred; *Lepidium virginicum*, ninety-four; *Erechthites hieracifolia*, none; *Euphorbia maculata*, none; *Lychnis githago*, none; *Anthemis cotula*, fifty-two; *Malva rotundifolia*, two (?); *Œnothera biennis*, eighty-two; *Plantago major*, none; *Polygonum hydropiper*, six; *Portulaca oleracea*, thirty-eight; *Quercus rubra*, none; *Rumex crispus*, ninety; *Setaria glauca*, sixty-eight; *Stellaria media*, seventy-two; *Thuja occidentalis*, none; *Trifolium repens*, four; *Verbascum thapsus*, eighty-four.——From the proceedings of the U. S. National Museum, we have a list, by Frank H. Knowlton, of the plants collected by C. L. McKay in Alaska, in 1881. In all 122 species are enumerated, distributed as follows, viz: Dicotyledons, eighty-seven; Monocotyledons, twenty-four; Conifers, one; Pteridophytes, five (one Equisetum, one Lycopodium, three ferns); mosses, four; lichens, one. No new species are described.——Professor Penhallow published, in the *Canadian Record of Science* for October, a paper upon the distribution of the reserve-material of plants in relation to disease, from which it appears that an abnormal storage of starch in the pith, wood and bark of the peach is associated with a deficiency of potash and chlorine and an excess of lime. This abnormal storage is accompanied apparently by imperfect nutrition, due to the loss of power of the tissues to dissolve the starch, which accordingly accumulates.——The July *Torrey Bulletin* contains a paper by Professor Trelease showing that the fungus parasitic on *Juncus tenuis*, and hitherto known as *Ustilago junci* Schweinitz, is properly not an Ustilago at all, but a species of Cintractia. Accordingly it must hereafter be known under the name of *Cintractia junci* (Schwein.) Trelease. The only other known species of the genus is *C. axicola* (B) Cornu, from the southern United States and the West Indies.——From a study of the development of the leaves of *Pinus monophylla* and *P. edulis* upon young trees growing upon his grounds in Germantown, Pa., Thomas Meehan concludes that the former is a depauperate state of the latter. His paper appears in the August *Torrey Bulletin*.——The "Association Number" of the *Botanical Gazette* (Sept. and Oct.) contains forty-six pages of interesting matter. We are much pleased to read the announcement that beginning with the new year the size of this indispensable journal will be increased to at least twenty-four pages per month. An exhaustive index to volumes I to X will be published at the close of the present year. ——Professor John M. Coulter's Rocky Mountain Flora is in press, and will soon appear. It is to be uniform with Gray's and Chapman's Manuals, and will include descriptions of the plants from about the 100th meridian westward, and extending from British America southward through Colorado.

## ENTOMOLOGY.

Occurrence of Colias nastes in the Pamir mountains.—In the Investia of the Russian Geographical Society is a paper by M. Grum-Grzimailo, who has journeyed, says *Nature*, in the mountains north of the Alay region of the Pamir, in Central Asia. On a rich Alpine pasturage, where Kirghizes are in the habit of staying, he found *Colias eogene*, *Arctia erschoffi*, etc., which are common almost exclusively to the Himalayas and the Southwest Thian-Shan. On the plateau between the Kara-Su and the Aram, with other rare Lepidoptera were species of Colias and Parnassius. On the Dje Kaindy pass, the Lycaenæ were numerous, so that in the space of three meters the author found fifteen species of them, of which three were unknown to him. Another find of great interest was that of *C. nastes*. The late Mr. Fedchenko had already caught one female butterfly, which was determined by M. Erschoff as *Colias nastes*. This species having been found formerly only in Labrador and Northern Lapland, the determination remained doubtful, the individual having been but a female. M. Grzimailo has caught a number of both males and females, which really proved both to belong to *C. nastes*. The writer says it remains now to explain the strange extension of this species. He does not seem to be aware that several (nine species) other Labrador Lepidoptera occur in the Altai mountains of Northeastern Asia.

The Eye and Optic Tract of Insects.—In his essay on this subject Dr. S. J. Hickson (Quart. Journ. Micr. Science, April) describes in detail the eye and optic tract of the flesh fly (*Musca vomitoria*). The pseudo-cones he has found to be composed of four cells, with their nuclei situated internally, each one containing a large watery or albuminous vacuole, which serves the same purpose, and is morphologically homologous with the crystalline cone of the "eucone" eyes. There are six retinulæ cells, each possessing a nucleus situated in that part of it which lies immediately behind the pseudo-cones, and in some cases an additional nucleus, situated about half-way down. He has figured for the first time the interommatidial tracheal vesicles which have been previously observed by several investigators. In the optic tract he has described three ganglia—the opticon, epi-opticon and peri-opticon. The last of these is composed of a number of small cylindrical elements of a tissue composed of a sponge-work of nerve-fibrillæ, which he has called a "neurospongium." The opticon and epi-opticon are present in all insects, and in most of the higher Crustacea. The peri-opticon appears comparatively late in development, but is never found even in the adults of Periplaneta and Nepa.

The peri-opticon, when present, is usually composed of a number of cylindrical elements, which partially fuse in Æschna and

completely in Eristalis, Bombyx and the Crustacea. In Eristalis the peri-opticon is traversed by a number of delicate tracheal vessels.

The terminal optic anastomosis of Nepa is more complicated than it is in Periplaneta, and seems to be an intermediate stage between the simple anastomosis, the true peri-opticon of Musca.

A similar series of intermediate stages between the simple anastomosis and a true peri-opticon has been traced in the development of these parts in the bee.

The development and comparative anatomy of the peri-opticon of insects is interesting, as it may indicate the mode in which central ganglia were first formed from primitive nerve-fibrils and cells.

His investigations seem to him to corroborate the opinion of the majority of previous investigators, that the retinulæ are the true nerve-end cells.

How Insects adhere to flat vertical Surfaces.—Herr H. Dewitz gives an account of some further observations on this subject, tending to prove that the secretion by which, *e. g.*, flies adhere to window panes, is not a thin fluid of a fatty nature, but much more consistent. He adduces experiments to controvert Rombout's view that a fly can maintain itself on a glass surface by one leg only, if that surface be vertical and if the body of the fly be in contact with the glass.—*Journal Royal Microscopical Society, October, 1885.*

Season Dimorphism in Spiders.—The researches of Weismann into the phenomenon known as seasonal dimorphism among butterflies, are well known. Something of the same kind is stated by Dr. F. Dahl to occur in spiders. In an earlier communication this author had pointed out the fact that *Micrommeta virescens* and *M. ornata* were simply two broods of the same species. He now advances another instance in *Meta segmentata* and *M. menger*, stating his reasons for believing them to be respectively spring and summer broods of the same species.—*Journal Royal Microscopical Society, October, 1885.*

Entomological News.—In the twenty-eighth volume of the Annales de la Société Entomologique de Belgique, we notice descriptions of the metamorphosis of *Leptinotarsa undecimlineata* Stál and *Tropisternus lateralis* Fabr., by Dr. Eug. Dugès of Mexico. In the first part of Vol. xxix of the same Annales C. Van den Branden publishes a catalogue of the aquatic carnivorous beetles. The family Dytiscidæ numbered, according to the Munich catalogue, 893 species; to-day the present catalogue enumerates over 1500 species. C. Kerremans also enumerates the Buprestidæ described since the publication of Gemminger and Harold's catalogue.—— In the Comptes-rendus of the same Society Mr. S. H. Scudder shows that the *Brachypyge carbonis*, described by Dr. H. Woodward as

the abdomen of a crab, is in reality the abdomen of an arachnid, of which six species are now known, one from the coal measures of Arkansas.——In A. Walter's article on the morphology of Lepidoptera in the Jenaische Zeitschrit for May, we have an account of the mouth-parts of Acentropus.——The transformations of *Paraponyx oryzalis*, an insect pest of the rice-plant in Burma, are described and well figured by J. Wood-Mason, in a pamphlet printed in Calcutta. Its larva is aquatic and breathes by tracheal gills. We wish the author had given more detailed sketches of the gills and their relation to the body.——We omitted to note Kowalevsky's contribution to the post-embryonal development of the Muscidæ in the Zoologischer Anzeiger for Feb. 23, 1885.

## ZOOLOGY.

THE SIGNIFICANCE OF THE CELL NUCLEUS TO THE PROBLEM OF HEREDITY.—The results of the later researches upon fertilization and cell division, have tended to make biologists view the cell nucleus as of pre-eminent inportance for the life of the cell. In 1884, Kölliker, in his Entwickelungsgeschichte, stated, that since fertilization consists essentially in the fusion of a male with a female pronucleus into one segmentation nucleus which entails its hermaphrodite character upon its offspring of cell generations during ontogenetic development, this fact gives us the true reason why, and how every organism resembles its parents. The last two years have been fruitful in discussions of the problem of heredity in the light of nuclear investigations and have stimulated Kölliker to expand the above statement with more completeness and detail in the paper[1] of which this article is an abstract.

From our present knowledge of the biology of the cell nucleus we may draw certain conclusions of great value as a basis for the discussion of the problem of heredity, as follows:

*The nucleus, and it alone, contains a substance which possesses the power of building up an organism according to specific characters*, making it resemble the parents from whieh the nucleus originally came—in other words, possesses the hereditary power.

This follows from:

(*a*) *The nature of the spermatozoön:*

We know that but one spermatozoön is needed in the fertilization of one egg; we know that this must carry the hereditary traits of the father which he received from his ancestors both male and female; each spermatozoön is a nucleus.

Kölliker, in 1844, held the spermatozoön to be the equivalent of a cell, but later came to the conclusion that it represents a nucleus. Other biologists agreed with Kölliker so far as the *body* of the spermatozoön is concerned; but the *flagellum*, they said represents the cell protoplasm; and hence a spermatozoön may

[1] "Die Bedeutung der Zellenkerne für die Vorgänge der Vererbung." Zeitschrift für Wissenschaftliche Zoologie. Band XLII, erstes heft. July, 1885.

still be the equivalent of a cell. This may be true, for instance, says Kölliker, for trematodes; but he has shown that for the higher vertebrates the spermatozoa are, in toto, nuclei. It therefore follows that in the spermatozoa of lower animals the nucleus is the necessary fertilizing part, the flagellum serving merely as a locomotor organ, being later absorbed by the yolk. The pollen grains of phanerogams are also nuclei.

(*b*) *The phenomena of fertilization:*

Since Bütschli, in 1872 discovered the two pronuclei in the newly fertilized egg, the phenomena of nuclear conjugation have been carefully studied, especially by O. Hertwig, Fol, and Van Beneden. It is agreed that the male element penetrates the yolk and unites with a portion of the egg-nucleus; but in some important details there is disagreement. The most complete observations have been made on *Ascaris megalocephala* by Van Beneden and by Nussbaum. These observers agree that only the nucleus of the zoösperm forms the male pronucleus; though Van Beneden, even here, finds a "perinuclear zone" which takes no part in the fertilization. It is also agreed that before being fertilized, or conjugating with the male pronucleus, the egg-nucleus throws off a portion of itself in the polar globules, by a complex process resembling indirect cell division. In this process it is generally agreed that the nuclear figure is divided equatorially; but Van Beneden strongly insists that the division is meridional. He further thinks the germinal vesicle is not an ordinary cell nucleus because *all* the chromatin is in the nucleolus.

Minot, Balfour and Van Beneden think all cells are hermaphrodite; and that before conjugation can take place the male cell must lose its female nuclein, and the female cell its male nuclein which is passed over into the polar globules. But against such an hypothesis there are grave objections.

(1) It is known that in the processes of spermatogenesis in many animals, no part of the spermatogonia is lost. (2) Usually two polar globules are successively formed by the repeated halving of the egg nucleus. Now to get rid of the male nuclein this substance must be so distributed as to be separated by the plane of division from the remaining or female nuclein; and then, the male nuclein would be lost in the first globule and there would be no need of a second. (3) We know that the spermatozoön confers hereditary traits from both father and mother upon offspring; and likewise for the female pronucleus. Therefore we conclude, the *pronuclei are essentially in their nature hermaphrodite.*[1]

Kölliker plausibly suggests that the function of the polar globules is simply to reduce the size of the egg-nucleus comparable to that of the male pronucleus.

[1] This word, hermaphrodite, means simply, that hereditary powers from two lines of ancestry, indefinitely dichotomously compounded, are combined, and not what we popularly understand by the term.—*J. N.*

The general law of fertilization, stated by Strasburger for plants, and which we see from the above holds also for animals, is:

*Fertilization consists essentially in the conjugation of male with female nuclei; these are ordinary cell nuclei; and the cytoplasm takes no part in the process.*

It is therefore erroneous to speak in a general way of the cell protoplasm as carrying the hereditary powers. Of the many writers who have treated this subject, only three or four have given more definite statements. Nägeli calls that substance *idioplasm*, which controls or determines the specific characters of the cell, but does not limit it to the nucleus as does Kölliker and Born. Strasburger distinguishes between two sorts of idioplasm, that of the cell (cyto-idioplasm), and that of the nucleus (karyo-idioplasm).

In the nucleus exists a substance of definite morphological and chemical character, known as nuclein or *chromatin*. *With this substance the idioplasm must be conceived as connected.* (1) The chromatin of the male pronucleus unites with that of the female pronucleus to form the chromatic figure of the segmentation nucleus. According to Van Beneden there is no union, but the chromatin loops of the pronuclei remain separate so as to give the segmentation nucleus a double character, morphologically, one-half being distinctly male and the opposite, female; and this holds true of all its offspring. But Nussbaum found that before segmenting, the nucleus has a stage in which the chromatin forms a single filament. Furthermore Van Beneden's own figures do not seem to Kölliker, to support his view. (2) The processes of karyokinesis show how important it is that the chromatin should be divided between the daughter nuclei in a definite way. It is natural to suppose that to distribute the hermaphrodite idioplasm to the daughter cells, so that each shall get its proper amount, must be a delicate process.

We have now to inquire how the idioplasm effects the work of heredity.

In the development of an egg into an adult there are two moments at work. First, the cells multiply until a sufficient number of cells needed by the organ is produced; second, these cells are separated into groups and are differentiated into the various tissues. We may refer to the cambium zone of plants for a familiar illustration.

The structural characters of any organism depend on these factors: (1) cell *division*, and (2) cell *growth;* both as to (a) *quantity*, and (b) *quality*.

Cell multiplication, if great, will produce a large organ; if less, a smaller. The multiplication may be uniform or may be more rapid at certain points. Thus in the arm rudiment, five points of rapid cell division alternate with points of rest, and the five fingers are produced. Lastly, the cell division may take place in one,

two, or three planes, and give rise accordingly to very different aggregates.

As to cell growth, the size will depend directly on it; but like multiplication, growth may affect some cells and not others; again, like multiplication, cell growth may take place in one, two, or three dimensions.

We can now readily see that *the quantity and quality of cell multiplication and cell growth, according to a specific type of combination for the different organs and thus for the whole organism, builds up the individual with its specific characters.*

Now, the nucleus governs cell multiplication. (1) Division of the nucleus leads in cell division. (The author here shows that certain apparent exceptions are not really so.) (2) The position of the nuclear spindle determines the plane of division.

The *nucleus* also *governs cell growth.*

(1) Young and active cells have conspicuous nuclei, while cells that have done their work are without them. (2) The size of the nucleus increases as the cell increases (cf. Actinosphærium). The nucleus in large cells may separate into many parts so that every portion of protoplasm shall have a nucleus to preside in it. In protozoa these nuclei fuse again before division of the cell, while cases where the mass breaks up without this union are where the nuclei have become independent cells, viz: swarm spores. (3) Artificial division of Protozoa, shows that pieces without a nucleus do not grow. (4) Free cell formation may be considered as due to the fusion of minute nuclei (vid. Berthold, Mitth. der Zool. Stat. Neapel, ii, p. 78) and around the nucleus thus arising a cell is formed. (5) As several of Haeckel's innucleate monera have shown nuclei, when treated with appropriate reagents, Kölliker expects that all will do so when investigated by the methods of an advanced staining technique. (6) The activity of the nucleus is shown by the rays that stream from it in the protoplasm, and by the active manner in which it reacts towards stains.

From this we conclude, that the nucleus has great and controlling significance for the cell, being in active relation to the protoplasm.[1] Some authors have given it the function of manufacturing albumen, chlorophyll, etc. The structure of the cell, in fact its life history, is conceived to depend on the nucleus, whose *idioplasm has a minute structure of a definite type for each species;* and on this structure will depend the method of its work and how it shall react towards external influences. Modifying forces

[1] Pfitzner, in a recent paper (Zur Bedeutung des Zellkerns, Morph. Jahrbuch xi, 1, p. 54), calls the chromatin the "*ground substance of life.*" He also shows, by the application of a new method of staining, that the nucleoplasm or achromatin remains distinct from the cytoplasm during all the stages of karyokinesis; that many so-called multiple nuclei are separated portions of chromatin imbedded in a continuous matrix of achromatin; and that modern cytologists have generally applied the term *nucleus*, to only the chromatic portion, wholly ignoring the achromatic.—*J. N.*

to influence heredity must affect this structure and thus only, can produce variation.

We have finally to inquire, what are the changes which the idioplasm suffers during the ontogenetic development of an organism? *Each cell which results from the segmentation of the first embryo nucleus must be the equivalent, in all respects, of this nucleus, and, theoretically, capable of reproducing the individual.* Weismann has a theory opposed to this view. According to this author, only the very earliest cells produced in segmentation are set apart as germinal cells; all others have lost the power to be germinal cells, but must invariably differentiate into the organs of the body. Thus we really have no death, but only a series of germinal cells which gives off, by cell multiplication, from the fertilized egg, a mass of cells which differentiates into the individual. This aggregate alone is dissolved in the process known as death.

Kölliker cannot accept this theory. Every organ begins in a mass of embryonic cells, from which parts may be renewed if lost. Cells that have differentiated may, under proper circumstances, regain their germinal power. The buds that appear at various points of a mass of embryonic vegetable tissue, essentially reproduce the structure of the individual. In plants, the germinal cells can not be said to be set apart early in life. (Compare also adventitious buds.) Even in the adult animal organism, occur embryonic cells, such as osteoblasts and odontoblasts, the deep cells of the epidermis, cells of many glands, lymph cells, and germinal cells. The last are themselves, like other cells, differentiated in a particular direction, some forming eggs and some spermatozoa. All asexual reproduction, such as fission, budding, parthenogenesis, shows that other cells besides germinal cells, can reproduce the organism. It would be an interesting inquiry to ascertain what circumstances cause the cells to reproduce the whole body or only a part. It is not necessary to hold the early differentiation of germinal cells, nor to locate them for all animals in the same embryonic layer, since all cells are primarily germinal cells like the fertilized egg; and according to the function they are to serve in the adult, they differentiate into the appropriate tissues.—*J. Nelson.*

The Retrograde Metamorphosis of Siren.—I have already pointed out (Naturalist, 1885, p. 245) that palæontology shows that the Batrachian order of Trachystomata, which embraces the Sirenidæ, is a degenerate type, if the structure of its skull, limb-arches and limbs be considered. I have now reason to believe that there are indications of a retrograde metamorphosis to be found in the history of its branchial apparatus. I have been for a long time at a loss to account for the curious condition which I have frequently observed in the branchiæ of the Sirens. The

fringes are frequently in a state of apparent partial atrophy, and enclosed in a common dermal investment of the branchial ramus, or all the rami are covered by a common investment, so as to be absolutely functionless and immovable. This character, observed in the *Pseudobranchus striatus*, gave origin to its separation from the genus Siren. The character is, however, common to the *Siren lacertina* at a certain age, and the real difference between the genera depends on the different number of the digits in the two.

I have been more than ever surprised on discovering that the functionless condition of the branchiæ is universal in young individuals of *Siren lacertina* of five and six inches in length; and lately I have observed that in a specimen of a little over three inches they are entirely rudimentary and subepidermal. I have, in fact, noticed that it is only in large adult specimens that the branchiæ are fully developed in structure and function. The inference from the specimens certainly is that the branchiæ are in the Sirens, not a larval character, as in other perennibrachiate Batrachia, but a character of maturity. Of course, only direct observation can show whether Sirens have branchiæ on exclusion from the egg; but it is not probable that they differ so much from other members of their class as to be without them. Nevertheless, it is evident that the branchiæ soon become functionless, so that the animal is almost, if not exclusively, an air-breather, and that functional activity is not resumed till a more advanced age. That Sirens may be exclusively air breathers I have shown by observations on a specimen in an aquarium which for a time had no branchiæ at all. (See Journal Academy Phila., 1866, p. 98.)

In explanation of this fact it may be remarked that this atrophy cannot be accounted for on the supposition that it is seasonal and due to the drying up of the aquatic habitat of the Sirens. The countries they inhabit are humid, receiving the heaviest rainfall of our Eastern States, and there is no dry season. The only explanation appears to me to be that the present Sirens are the descendants of a terrestrial type of Batrachia which passed through a metamorphosis like other members of their class, but that more recently they have adopted a permanent aquatic life, and have resumed their branchiæ by reversion.—*E. D. Cope.*

Recent Additions to the Museum of Brown University.—Of late there has been made at this institution considerable effort to secure indigenous representatives of the animals which occur in the neighborhood of the college, and especially of such as are likely soon to be exterminated from the narrow bounds of Rhode Island, the most thickly settled State of the Union. Within a few weeks there has been secured a local representative of Blanding's box tortoise (*Emys meleagris*), an animal well deserving a position in the cabinet, as both an early describer, Dr. John E.

Holbrook, and the person to whom he dedicated the species, Dr. William Blanding, were graduates of this college. A representative of the musk turtle (*Aromochelys odoratus*) is interesting in that it is a giant of its species, the carapax measuring four and one-half inches in length. An otter (*Lutra canadensis*) is also worthy of note, as it is an animal extremely rare in this region. This specimen was shot on the island of Rhode Island, and was large and in excellent condition, a state of health somewhat different from that presented by an emaciated wild cat (*Lynx rufus*), captured in the more southern portion of the State, and probably the last Narragansett representative of its species.

Perhaps the most interesting acquisition is that of a hoary bat (*Atalapha cinereus*). This animal, a beautiful female, was found a few miles from Providence, on a pine tree which had been recently felled. Dr. C. Hart Merriam, in writing of this species, says: "From its almost boreal distribution, and extreme rarity in collections, the capture of a specimen of the hoary bat must, for some time to come, be regarded as an event worthy of congratulation and record. Although I have been fortunate enough to shoot fourteen, I would rather kill another to-day than slay a dozen deer."—*H. C. Bumpus.*

Zoological News.—*Echinoderms.*—Twenty species of Echini were, according to Mr. R. Rathbun, collected during the expedition of the *Albatross* in 1884. They include *Homolampas fragilis* and *Aceste bellidifera.* The latter species was only obtained by the *Challenger* in the vicinity of the Canaries, and was not found by the *Blake* in the Gulf of Mexico. The *Albatross* obtained it off the east coast of the United States, in 1497 fathoms.

*Crustaceans.*—S. J. Smith describes *Eunephrops bairdii*, n. gen. and sp., a relative of Homarus (Proc. U. S. Nat. Mus., 1885, 167). The writer compares the species throughout with *Nephrops norvegicus.* The genus agrees with Homarus in the number and arrangement of the branchiæ, with Nephrops and Homarus in possessing antennal scales and well-developed eyes; with Nephropsis in having very large antennal spines, and with Nephrops in its slender and carinated chelæ. One specimen, female, was dredged by the *Albatross* in the Gulf of Darien, 155 fathoms.—The same naturalist also contributes a paper upon some genera and species of Penæidæ, mostly from recent dredgings of the United States Fish Commission. The new species are *Parapenæus megalops* and *goodei, Hymenopenæus robustus* and *modestus.*

*Mollusks.*—W. H. Dall contributes notes on some Floridian land and fresh-water shells, with a revision of the Auriculacea of the Eastern United States. *Hydrobia wetherbyi* and *Pupilla floridana* are described as new, also *Sayella crosseana* and *Onchidium floridanum.*

*Fishes.*—D. S. Jordan and S. E. Meek (Proc. U. S. Nat. Mus., April 20, 1885) give a list of fishes collected in Iowa and Missouri, with descriptions of the new species, *Notropis gilberti* and *Ammocrypta clara.*——S. Garman (l. c., April 23) describes as new *Mylobatis goodei*, from Central America; *Dasybatus kuhlii; D. varidens*, from Hong-kong; *Urolophus nebulosus*, from Colima, Mexico; *U. fuscus*, from Niphon; *Raja fusca*, also from Japan; *Raja senta*, from deep water off the coast of Massachusetts, and *R. jordani*, from San Francisco, California.——D. S. Jordan and S. E. Meek (Proc. U. S. Nat. Mus., 1885, 44) give the synonymy and an analytical key of the American species of Exocœtus. The authors admit seventeen species, fourteen of which they place in Exocœtus, while the remaining three are placed in three other sub-genera. Most of the species have a very wide range. *E. californicus* is probably the largest species. ——A study of the skulls and vertebræ of twenty species of Etheostomatinæ or darters, made by D. S. Jordan and Carl H. Eigenman, has induced the former to replace these little fishes in the Percidæ. "The Etheostomatinæ are near allies of the Percidæ, and should not form a separate family."——T. H. Bean (l. c. 73) describes *Plectromus crassiceps*, a single example of which was taken by the *Albatross* at the greatest depth explored, viz., 2949 fathoms, and three other examples at lesser depths. The same ichthyologist describes *Aspidophorides güntheri*, from Alaska.—— A writer in the Bulletin of the U. S. Fish Commission states that he has been a witness to the destruction of just-hatched trout by mosquitoes. When a young fish came to the surface in the sunshine, a mosquito immediately transfixed its brain with its proboscis, and held on until the life juices were sucked away, when the dead trout floated down stream. The locality was the Gunnison valley, Col.——Mr. J. A. Ryder has contributed to the Proceedings (U. S. Nat. Mus., 1885), a most valuable paper upon the development of viviparous osseous fishes. He quotes the observations of Girard and Blake upon the Embiotocidæ of the Pacific coast, and adding observations of his own upon the gravid females of three species, arrives at the conclusion that: (1) the hypertrophied hind gut of embiotocid embryos, clothed internally with crowded villi of great length, has probably a digestive function, enabling the young fish to assimilate the nutriment contained in the abundant fluid given out by the walls of the ovarian sac; and (2) that the great development of the interradial membrane of all the vertical fins, and the abundance and size of the blood vessels which supply that membrane, are mainly for the purpose of effecting respiration through the skin. In the later stages of development the protruding hind gut commences to diminish in size. In *Gambusia patruelis* each egg and egg-sac has its own independent supply of blood from the mother's arterial system. The

male is scarcely one-sixth the weight of the female. There is no trace whatever in the egg follicles of Gambusia of an independent egg membrane. The developing young of Gambusia obtains no nutrition from its parent.——The same ichthyologist contributes a paper on certain features of the development of the salmon.——Dr. Bean describes *Stathmonotus hemphillii*, a small fish from Key West, Fla., related to Muræenoides.

*Batrachians.*—O. P. Hay (Proc. U. S. Nat. Mus. 1885, p. 209), describes as new *Amblystoma copeianum*, from Indiana. It is without the yellow spots of *A. tigrinum*, has a lateral brown band, a broader and more depressed head, a more compressed tail, and longer limbs than *A. tigrinum*.——The brothers P. B. and C. F. Sarasen show that the genus Epicrium is not viviparous, as is Cæcilia, but oviparous. In the most advanced stage before hatching, the embryo is provided with very long blood-red external gill-filaments, and has also a distinct tail with a strong fin. The gill-filaments are shed previous to hatching, after which the young Cæcilians make their way to the neighboring stream, in which they breathe by means of gill-slits. After they leave the water their gill-slits close up, and they breathe by lungs. There is a fourth gill-arch, from which the pulmonary artery is given off. The spermatozoön has a spiral filament. The last two facts tend to show that the Cæcilians are nearer to the Urodela than to the Anura.——It has been shown that the old species *Rana temporaria* contains many specific forms that have been confounded because of great resemblance in coloration and habits. M. G. A. Boulenger distinguishes eight species of red frogs or *Ranæ temporariæ*, viz., *R. fusca, arvalis, sylvatica, iberica, latastei, japonica, agilis, and pennsylvanica.* Exteriorly these forms differ in the greater or less length of the pelvic members, the shape of the head, the size of the tympanum, the greater or less development of the tubercle of the first cuneiform bone, the presence or absence of the vocal sacs in the male, etc. The vomerine teeth differ as do also the genital organs of the males. In the species with vocal sacs, or at least in *fusca* and *arvalis*, the throat of the males becomes blue in spring, and a bluish tint invades the skin. The arms of the males, always more robust than those of the females, become thicker still in the rutting period, and the thumb then becomes covered with rugosities. Copulation takes place at the end of winter or in early spring, when the males may be seen firmly seated on the females, with their arms around them and their hands joined over the breast. *R. sylvatica* and *R. pennsylvanica* are American, *R. japonica* is found in China and Japan and the others are European. *R. fusca* is found in most of Europe, except Southwest France and Spain; *R. arvalis* is found in the Northeast of Europe and probably in Northern Asia; *R. iberica* is limited to Spain and Portugal; *R. latastei* is found in Northern Italy, and *R. agilis* in

France, Switzerland and Northern Italy.——G. A. Boulenger calls attention, in the *Zoölogist* to the existence of two kinds of aquatic frogs in North Germany. Though included as sub species of *R. esculenta*, they can be distinguished from each other at first sight, and breed at different times of the year. In the typical *R. esculenta*, the inner metatarsal tubercle is compressed and large, and the black marbling of the flanks and hinder side of the thighs encloses more or less of bright yellow; while in the larger variety, *R. fortis*, the inner metatarsal tubercle is small, elongate, and feebly prominent, and there is no yellow on flanks or thighs. The whole physiognomy is different and the fact that the larger kind breeds earlier keeps the breeds pure.

*Reptiles*—G. A. Boulenger describes *Agama doriæ*, a new lizard from Bogos in Northern Abyssinia. In proportions and characters of the scales it is similar to *A. colonorum*, between which and *A. bibronii* it is intermediate.——Dr. O. Boettger's list of the reptiles and Batrachia of Paraguay, comprises sixty-three species collected by H. Rohde, of which nineteen are lizards and twenty-four snakes. The new lacertilian genus Micrablepharus, is instituted for *M. glaucurus*, and other new species are *Amphisbæna albocingulata*, *Lepidosternum boulengeri*, *strauchi*, *affine* and *onychocephalum*, *Mabuia tetratænia*, *Liophis genimaculata*, *Rhinaspis rohdei*, *Leptognathus cisticeps*, and the batrachians *Engystoma albopunctatum* and *mulleri* and *Leptodactylus diptyx*.

*Birds.*—The collection of "Birds of the British Asian Empire," recently donated to the British Museum by Mr. O. O. Hume of Simla, contains 63,000 skins of birds, 300 nests, and 18,500 eggs. It contains about 2000 species, each represented by some thirty examples, mostly representing different stages of growth or degrees of variation. Mr. Hume has been the best authority on Indian ornithology, and intended to publish a work on the "Birds of the British Asian Empire," but other duties, and the loss by theft of his manuscripts, determined him to donate his collections to the British Museum, that they might be worked up by Mr. Sharpe.——R. Ridgway (Proc. U. S. Nat. Mus., April 20, 1885) describes a new more brightly colored variety of *Icterus cucullatus* from Yucatan; *Centopus pileatus* from some part of Tropical America; *Cyanocorax cucullatus* and a variety of *Vireolanius pulchellus* from Costa Rica, and *Certhiola finschi* and *C. sundevalli* from the Lesser Antilles. Mr. Ridgway also gives a key to the species of Certhiola (honey creepers) and gives the name of *Branta minima* to a very small form of barnacle goose which breeds in Western Alaska and migrates south to California in winter. *Onychotes* (*Buteo*) *gruberi* Ridgway, formerly thought to be a Californian bird, is now by its original describer, on the faith of a plate published in the report upon the birds of the *Challenger* Expedition, considered a synonym of *Buteo solitarius*, from the Sandwich islands. Mr.

Ridgway also describes *Cancroma zeledoni*, from Central America, and *Rupornis gracilis*, from Yucatan.——L. Steyneger describes (*l. c.*) a new species of tree-sparrow *(Passer saturatus)* from the Liu-kiu islands.——José C. Zeledon contributes to the Proc. U. S. Nat. Mus., a list of the birds of Costa Rica, 692 species in all.——L. M. Turner gives (*l. c.*, 233) a list of the birds of Labrador from Hudson strait to the Gulf of St. Lawrence, and west to 82° W. long., 764 species in all.

*Mammals.*—F. W. True (Proc. U. S. Nat. Mus., 1885, 95) describes as new *Phocæna dalli*, and reduces the previously described species of porpoise to three, viz: *P. communis*, *P. lineata*, and *P. spinipinnis*. In coloration, in the form of the head, and in the much larger number of vertebræ, *P. dalli* approximates Lagenorhynchus. A cordate area of white occupies the belly and lower half of the sides; the beak is shorter and the temporal fossæ smaller than in *P. communis;* the vertebræ are ninety-seven or ninety-eight in number, instead of sixty-six, as in *communis*, and the dorsal fin is concave on its posterior margin. The Aleuts, according to W. H. Dall, recognize this species as distinct from the smaller *P. vomerina (= communis?)*.

## EMBRYOLOGY.[1]

THE DEVELOPMENT AND STRUCTURE OF MICROHYDRA RYDERI POTTS.—The discovery and prolonged observation in the living state of this remarkable fresh-water cœlenterate, which is obviously allied to Hydra, is due to the painstaking care of Mr. Edward Potts, who found it adherent to stones to which fresh-water Polyzoa were attached, which he brought from Tacony creek, near Philadelphia. Mr. Potts has named the animal for the writer,[2] to whom he has also turned over three series of sections, prepared by Mr. Harold Wingate, from three individuals. Fortunately two of these series of sections, one a slide containing forty-two transverse, and another nine longitudinal sections, enables me to make a very thorough comparison with the structure of Hydra as displayed in a series of sections of *H. viridis* and *H. fusca*, from both of which Microhydra differs not only in size but also in histological details as well as in its mode of development. This singular organism also differs widely from the marine *Protohydra leuckartii* Greef, in being very much smaller, and in being an inhabitant of fresh water; it also differs from Protohydra in its method of reproduction by gemmation from the side of the body instead of by transverse fission. In this last

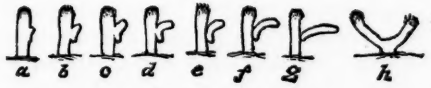
[1] Edited by JOHN A. RYDER, Smithsonian Institution, Washington, D. C.

[2] *Science*, Vol. v, 1885, No. 123, in the accompanying cover sheets, called the *Science Bulletin*, p. v, under the head of Recent Proceedings of Societies, the name *Microhydra ryderi* was first published, together with a brief account of its structure and habits, as a report of a verbal communication made by Mr. Potts at the meeting of the Academy of Natural Sciences of Philadelphia, held May 19, 1885.

feature, or in respect to its gemmiparous development, Protohydra agrees with the Acraspeda or Discophora, in multiplying by transverse fission, such as is seen in the asexual Strobila stage of the latter. In one important feature Protohydra and Microhydra agree, namely, in that neither form possesses the slightest traces of tentacles. The widely different habitats of the two forms, as well as their diametrically opposite methods of gemmiparous reproduction, leads me to the conclusion that they are not very closely related. Its affinities are clearly with Hydra, but that it cannot in any sense be regarded as a mere stage of the development of the latter, follows from other considerations which I will now state.

Its minuteness might very readily lead to its being overlooked. It measures alive .5$^{mm}$ in height; the longitudinal sections in my possession are somewhat shorter, or about .475$^{mm}$ in length, a difference probably due to contraction. Its diameter at the oral end is somewhat greater than at the base, and ranges from about .15 to .175$^{mm.}$ In fractions of inches its dimensions are: height $\frac{1}{60}$ inch, diameter of body $\frac{1}{160}$ inch, constituting it the most diminutive adult hydroid or cœlenterate type yet known, so that its generic name is especially appropriate. In life the animal is very much less contractile than Hydra, and is without the well-defined pedal disk of the latter or of Protohydra.

No sexually mature individuals of Microhydra have been found by Mr. Potts, who has, however, most laboriously and carefully studied the gemmiparous or asexual reproduction of the species in the living animal, he having been able, in fact, to watch this process in several successive generations. The asexual reproduction of Microhydra is, however, so very different from that of Hydra that there can again be no doubt of the absolute distinctness of the two forms in question. In Hydra the gemmiparously produced young animal, which is budded from the sides of the body, soon becomes pyriform, buds out tentacles and is constricted off from the parent by transverse fission around its base or pedal disk. In Microhydra a very different method of lateral gemmation occurs, since the bud very soon becomes sausage-shaped instead of pyriform, but it grows out from a swelling or thickening at the side of the parent the same as in Hydra. In Microhydra a constriction or furrow appears at either end of the young bud as soon as it is well defined as such. The gradual




*Microhydra ryderi.*

progress of the development of a bud is shown in Figs. *a*, *b*, *c*, *d*, *e*, *f* and *g*. The last shows the young Microhydra in the act

of being detached from the parent. These figures are from sketches by Mr. Potts as the process was watched by him at different stages. It is clear from these figures that the process of gemmation in Microhydra is very different from that seen in other hydroids; it is, in fact, as if both ends of the young polyp were being budded out of the side of the parent simultaneously, final separation of the bud occurring at one of its sides instead of at its base. The process thus actually makes something of an approach toward longitudinal instead of transverse fission.

The bud after detachment drops down upon an adjacent surface and for a time lies quite prone upon its side. It is entirely without cilia, in this respect resembling the larvæ of Hydra. It, however, seems possessed of slight powers of locomotion, which is effected probably by the contractions of the body. After lying in its prone position for a time, the vermiform body of the polype becomes fixed to the foreign object upon which it rests, by one end, while the other end is slowly raised into the erect position, when it may be said that the creature is adult. The history of the internal changes which the larva undergoes while budding are not known, but it is probable that the bud has the oral opening developed at its free end by the time it assumes the erect position.

Colonies of two have been observed by Mr. Potts, appearing somewhat as in the sketch in Fig. *h*. This indicates that Microhydra in common with all other Cœlenterata has a tendency to form compound individuals or corms. Whether the stomachs of such compound individuals open into one another has not been ascertained, but it is extremely probable that they do. The preceding evidence, taken as a whole, it seems to me, leaves absolutely no doubt respecting the distinctness of the remarkable little organism discovered and so patiently studied by Mr. Potts.

The structure of the body in the Hydra and Protohydra agree pretty closely; in both there is an outer ectodermal layer, throughout which the nematocysts are pretty uniformly distributed. Under the ectoderm of both there is a thin layer consisting of contractile processes of the ectodermal cells. The endoderm consists in both of large vacuolated cells, containing excentrically placed nuclei and great numbers of granules at their inner ends. These large vacuolated, endodermic cells seem to line the whole internal cavity in both of the genera named.

In Microhydra the structure of the body is different from either of the preceding. There is a thin outer ectodermal layer, but the nematocysts are mainly aggregated at the oral end of the creature, few being present on the sides. Under the ectoderm there is a barely discernible thin stratum consisting very probably of the contractile processes of the outer layer cells. Around and just within the lips of the oral aperture the endodermic cells are solid. Just below the oral opening and for about one-third the

length of the animal, the endodermic cells are large and vacuolated as in Hydra, but the excentrically placed nuclei are absolutely and relatively very much smaller than in Hydra. There is a gastric cavity extending down from the mouth for about the same distance, below which the alimentary cavity becomes less apparent and is surrounded by solid endodermic cells. These details are shown in both the longitudinal and transverse sections. In the cross-sections evidences of slight irregular foldings of the endoderm are present as in Hydra.

Greef has described a homogeneous cuticula covering the basal part of the ectoderm of Protohydra. A similar homogeneous cuticula seems to loosely invest the ectoderm in the sections of Microhydra. Mr. Potts, however, is not disposed to agree with me on this point, as he informs me by letter that he was unable to detect any such envelope in the living larvæ studied by him.

There is a distinct but small oral opening at the upper end of Microhydra, which is cleft-like or irregular, through which food is taken in, as observed by Mr. Potts. The gastric cavity is small and only the upper end of it appears to possess a specially developed digestive function. The digestive cavity of Microhydra is, in fact, but little more developed than in the later planula-stage of such a form as Eucope. In fact, if the planula of the latter were to lose its cilia, become fixed and acquire a mouth, the morphological complexity of Microhydra would be realized. We have then in Microhydra an adult type which represents practically a planula which has acquired a mouth. In other words, the new type is not only the simplest of Hydroids, but is also the simplest of all true polypes or Cœlenterata. It is, in fact, a much more rudimentary form than even Protohydra, and represents perfectly a permanent gastrula which reproduces itself by lateral gemmation instead of by transverse fission.

It has been contended by some that Hydra is a degenerate form, and that Protohydra and Microhydra must be considered in the same light. As no very cogent reasons have ever been adduced in support of such a conclusion, I shall leave the *onus probandi* to be produced in favor of that view by those with whom it originated. The very simplicity of the type in question, it seems to me, must ever remain a serious bar to arriving at any very certain conclusions on this head. It seems as impossible to me to prove that Microhydra has been developed by the degeneration of a higher type, as it does to prove that it is a form which has advanced but very little beyond the planula stage of the Cœlenterata. The latter view seems to me to be by far the most probable, since it is a free-living form, which is no more likely to have been adversely affected than would hundreds of others living in the same environment. The significance of this singularly interesting type in relation to the question of the possible origin of the Cœlenterata is very great, and the interest which attaches to

it from the standpoint of the embryologist, it seems to me, fully warrants its discussion in this department.

With the help of Mr. Potts, who has generously given me permission to do so, I propose at an early date to prepare a more extended paper on this organism, with good illustrations. As it is, I must express my great obligations to its discoverer for the free use of many of the facts detailed above.—*John A. Ryder.*

[As this note on Microhydra goes to press, I have met with a paper[1], published in the Proceedings Royal Society, London, Vol. XXXVIII, No. 235, Dec. 11th, 1884, pp. 9–14. According to this account, the supposed hydroid phase of Limnocodium is without tentacles; it was found attached to roots of Pontederia in the tanks of the Royal Botanic Society, Regent's park. The figures given by Bourne of the suspected hydroid phase of the singular fresh-water Medusa known as Limnocodium, are certainly very similar to Microhydra, but the former is larger than the latter and measures from $\frac{1}{50}$th to $\frac{1}{8}$th of an inch long. Colonies of three or four individual zoöids were frequently met with. No true perisarc or cuticula was observed as in Microhydra, but the surface is covered with particles of mud and other *débris*, which becomes glued together by some secretion of the animal, and forms a sort of tubular casing. In internal structure this hydroid stage of Limnocodium differs considerably from Microhydra, however, judging from Bourne's description and figures. Is it possible after all that Microhydra is only the hydriform stage of fresh-water Medusa? If so, it is very probable that it may be allied to Limnocodium, the latter of South American origin, has in all probability a very different life-history from the North American Microhydra, if we may go so far as to assume that the latter has a medusiform adult stage. No lateral budding and dehiscence has been observed to occur in the supposed hydroid phase of Limnocodium, such as takes place in Microhydra, besides the larger zoöids of the former were over six times as long as those of the latter, otherwise there are many striking similarities. Notwithstanding the existence of these resemblances, I think we may assume that if Microhydra should turn out to be only the hydroid stage of a mature medusa-form the latter will be found to be generically distinct from Limnocodium, in which case it might be called Pottsia.—*J. A. R.*]

## PHYSIOLOGY.[2]

RECENT BELIEFS CONCERNING CELL-STRUCTURE.[3]—Probably no branch of biology has been so richly developed during the last five years as that which concerns the intimate physical and chemical

[1] On the Occurrence of a hydroid phase of *Limnocodium sowerbii* Allman and Lankester, by Alfred Gibbs Bourne.

[2] This department is edited by Professor HENRY SEWALL, of Ann Arbor, Michigan.

[3] *La Biologie Cellulaire*, par le Chanoine J. B. Carnoy, Lierre, 1884.

structure of living cells. In 1665, fifty years after the invention of the microscope, Robert Hooke found that plants were made up of minute "cells and pores." For more than a century after, cells were regarded as tiny vesicles filled with an homogeneous fluid; then, in 1781, Fontana, discovered the cell-nucleus. In 1836, just about the time when the great generalization of the cell doctrine was receiving its first impulse, Valentin described the nucleolus. The work of Carnoy is an interesting account of all that the most refined methods of investigation have been able to discover in the morphology and chemistry of the cell. Carnoy's description is so minute, and goes so much beyond the statements of some of the most trustworthy observers, that the careful reader who has not repeated his demonstrations is apt to view it with suspicion.

But, judged by internal evidence, the work has been performed with skill and conscience; the author describes minutely his methods and the nature of the material employed, relying chiefly upon the examination of fresh tissues. The illustrations are all new and uncommonly well executed, but the reader has a right to complain at the complete omission of an index to the contents of the book.

In 1859 Stilling discovered a fibrillar structure in ganglionic cells, and in 1864 Leydig described a similar appearance in the intestinal cells of certain small crustaceans. In 1865 Frommann announced that the fibrillar structure was a general character of living cells and in 1873 Heitzmann arrived at the same conclusion. The existence of fibrils in the cell may be considered established as a general property of living tissue, but authors are by no means agreed as to the distribution and character of the fibrillar structure. Carnoy considers that all cell structure has been gradually differentiated from original formless, homogeneous protoplasm; the typical cell, however, is a very complex apparatus. Taking as an example an epithelium cell from the intestine of the wood-louse, Carnoy describes the cell as composed of hyaline protoplasm inclosed in a membrane, and including a greater or less number of granules. Imbedded in the protoplasm is a nucleus with a membrane of its own.

The cell protoplasm is not homogeneous but is traversed in all directions by a dense reticulum of fibrils, which is attached to the membrane of the nucleus on one hand and to the cell wall on the other. The nucleus exists like a small cell within the substance of the larger. But in the nucleus the fibrillar structure is two-fold in nature. The most evident of these is a convoluted filament of very striking presence and complex internal structure. It stains deeply with coloring reagents, dissolves in dilute alkalies and in strong acids; it forms a gelatinous mass with sodium chloride ten per cent, but dilute acids have no effect upon it; it is not digested by artificial gastric juice, but with iodine, and with Millon's

reagent it acts like an albuminoid. This filament appears to have the chemical characters of nuclein; it is identical with the chromatin of Flemming, and is the structure which takes so characteristic a share in the process of cell division. Carnoy insists, in contradiction of Flemming, that the nuclein or chromatin substance is not characteristically in the form of a net-work, but consists of a single complexly convoluted fibril. The filament may occasionally form a true reticulum, but this is an unimportant modification of the typical single thread structure. The nuclein filament may alter and undergo a retrograde metamorphosis with age, and in cases completely disappear; in this process the filament breaks up into irregular pieces which may be gradually absorbed. The presence of the nuclein filament is the only thing which distinguishes the nucleus either chemically or structurally from the rest of the cell. After solution of the nuclein or chromatin filament, a second structure is discovered in the nucleus, namely, a fine reticulum which has all the characters of that previously described as existing in the extra-nuclear protoplasm. In his later work, Flemming is said also to have admitted the existence of this intra-nuclear net-work. The wall of the nucleus is imperforate and, in contradistinction to Klein, there is no direct union between the nuclear and extra-nuclear reticulum of fibrils. The reticula are much more resistant towards solvents than are most albuminous substances. The fibrils of the nucleus are insoluble in water, alcohol and ether; in sodium chloride ten per cent, in dilute acids and, at a low temperature, in strong acids and alkalies; the reticulum is not digested by artificial gastric juice. The formless protoplasm in the meshes of the net-work contains much water holding albuminoids in solution and granules of various kinds in suspension. The author believes that all the reticular substance of the cell is especially endowed with the properties of irritability and contractility, while the more fluid protoplasm within its meshes is the seat of the general chemical changes of the cell.

The cell-wall is differentiated from the protoplasm by a series of very gradual changes. The outermost layer of protoplasm takes on modified physiological characters. While still living and contractile it becomes much the most resistant part of the cell toward reagents, even more so than the substance of the reticulum itself. The membrane, like the cell matter, is made up of a close reticulum of fibrils whose interstices are filled by a more fluid substance. By a series of insensible gradations the protoplasmic membrane may be differentiated into a rigid, inert cell envelope. The various markings which are so striking a feature in the walls of many cells, both animal and vegetable, probably owe their foundation to this complicated structure of the original living cell-membrane.

Nucleoli of two distinct kinds have been confused together by

authors. The first of these consists merely of detached pieces of the nuclein or chromatin filament. The second kind of nucleolus is only a nucleus in miniature, and is quite independent (Strasburger to the contrary) of the chromatin filament. This nucleolus is a reserve fund for the use of the nuclear protoplasm and true nucleoli disappear during the process of cell-division. The membranes of cell and of nucleus are identical in their general characters.

The peculiar parallel streaks which are found connecting the two rosettes of chromatin substance after these have separated during cell-division, Carnoy declares to be formed by the fibrils of the reticula found in the membrane and protoplasm of the mother nucleus, the parallelism being caused when the mother nucleus pulls itself apart. After complete formation of the daughter nuclei, the parallel fibrils become again transformed into the protoplasmic reticulum of the new cells. A rather full list of references to work on this subject may be obtained by consulting Carnoy, *op. cit.;* Flemming, Virchow's Archiv, 1879, Bd. 77, p. 1; Arnold, same volume, p. 181. The English reader may find a good general review of the subject in *Quart. Journ. Mic. Sci.*, 1882, p. 35.

THE PHYSIOLOGICAL CHEMISTRY OF THE KIDNEY.—It has been made almost certain by the various labors of Ludwig, of Heidenhain and of Nussbaum, that the kidney tubules where lined by cells containing considerable protoplasm are differentiated in their function from the thin walled Malpighian capsules at the extremities of the tubules. The commonly received opinion is that the wall of the capsule serves simply as a diffusion and filtration membrane through which pass water and inorganic salts which make up the bulk of the urine; while the large-bodied cells of the tubules, particularly of the convoluted portions, may be looked on as true secretory mechanisms which have the power of actively selecting certain substances, as urea and urates, from the lymph, and probably also of manufacturing specific products. Dr. Dreser comes forward to extend the evidences for a differentiation of function between the two parts of the secretory mechanism of the kidney. Dreser, experimenting on frogs, thinks he has shown that the fluid passed through the capsules of the kidney is *alkaline*, while that secreted by the convoluted portions of the tubules is *acid* in reaction.

The results of the work depended upon the peculiar behavior of "acid fuchsin" toward alkalies and acids respectively; the former render it colorless, while the latter restore its red tint. A five per cent to ten per cent so lution of acid fuchsin is injected into the lymph sac of a frog and in half an hour the urine, drawn by a catheter, is distinctly red. If sufficient material be injected the red tint of the fluid becomes less deep, but still is immediately

intensified by the addition of acid; this indicates that the kidney still secretes the injected fuchsin, but that its power of forming acid is diminished, probably due to fatigue of the secretory protoplasm. The kidney, examined microscopically early in the experiment, offers nothing peculiar in its appearance, all parts are equally colorless; but when fuchsin has been continuously eliminated during some hours the cells of the convoluted portions of the tubules are found stained deeply red, while the capsules are quite without color.

Heidenhain found in his researches on the elimination of indigo-carmine by the kidney that the nuclei of the cells were always deeply stained; but Dreser could, in his experiments, scarcely ever make out a reddening of the nuclei, though the cells were often so deeply stained that their outlines were indistinguishable. The author's lengthy discussion of the chemical-physiological bearings of his results cannot be given here.—*Zeitsch. f. Biol., Bd. xxi, p. 41.*

A Valuable Series of Physiological Journals.—The library of the University of Michigan has recently been enriched by the addition of a series of German journals of anatomy and physiology which represents the current progress of those sciences almost continuously from 1796 up to the present time. Reil's Archiv f. d. Physiologie was first published in 1796 and continued until 1815. Meckel's Archiv f. d. Physiologie extended from 1815 to 1823, and was succeeded in 1826 by Meckel's Archiv f. Anat. u. Physiol., which was given up in 1832. Müller's Archiv f. Anat. Physiol. u. Wiss. Med., continued from 1834 till 1858, and was succeeded by Reichert and DuBois Reymond's Archiv f. Anat. Physiol. u. Wiss. Med., which was published from 1859 till 1876. This in turn was succeeded in 1876 by the Archiv f. Anat. u. Physiol., at present edited by Professor DuBois Reymond. No physiologist can contemplate this splendid series of works without thoughtful and affectionate interest, for it forms the log-book of the progress of modern physiology. Reil, in the opening pages of his first volume written in 1795, strikes the key-note of modern physiological research, and some of his words seem like a prophecy which the history of ninety years has fulfilled. Says he, "It is indeed remarkable that physiology, if I exclude anatomy from it, has made relatively less progress than almost any other science and is, for the most part, but a waste of unfounded or senseless hypotheses. * * * * We seek the explanation of the phenomena of animal life in a supersensuous substratum, in a soul, in an universal spirit of nature, in a principle of vitality, which we picture as something uncorporeal, and we are thereby either hampered in our investigation or actually led astray. * * * * We must no longer regard the animal body as something of wholly mysterious and unthinkable prop-

erties, but, if we except the mental side, as a merely physical object included in the category of natural bodies; an object which is subject to the same laws of nature as are wood and iron, but which, nevertheless, like wood and iron, has its own peculiar qualities."

THE HISTOLOGY OF STRIPED MUSCLE-FIBER.—Mr. B. Melland makes an important contribution to the literature treating of the structure of muscular tissue. His view is a confirmation and extension of that long since announced by Schäfer (Quain's Anatomy, 2d vol.). The following is a summary of the author's main results: "There is an intra-cellular net-work present in the muscle-fiber of Dytiscus, the bee, frog, lobster, crayfish and rat, which may be most clearly demonstrated by certain methods of gold staining. The net-work alone is stained by the reduced gold, and, owing to this differentiation, is plainly visible with comparatively low powers. This net-work may be demonstrated, though not so completely, in the living fiber, and in acetic and osmic acid preparations. Crossing the fiber transversely, united to the sarcolemma, and more or less separating the muscle-fiber into compartments, are net-work partitions—the transverse net-works. Running longitudinally down each compartment, and joining the dots at the intersections of the fibers of the transverse net-work, are a series of fine rods. This net-work consists of an isotropous material, and is more highly refractile than the rest of the muscle substance, which is anisotropous. This net-work serves to explain the transverse striation and other complicated appearances presented by the muscle-fiber, and brings into harmony many of the conflicting statements of histologists on this subject."—*Quart. Journ. Mic. Sci., 1885, p. 371.*

## PSYCHOLOGY.

INTELLIGENCE OF THE ELEPHANT.—In his interesting Two Years in the Jungle, Mr. Hornaday, gives us these impressions of the intelligence of the elephant:

The elephant is the most patient and obedient of all animals, and by far the most intelligent. He has more ability to reason from cause to effect than most other animals of docile temperament, and he is, beyond all question, the most capable of being taught, and the most willing to obey after he has been taught. To me it is a matter of surprise that Mr. Sanderson, who has, I presume, more personal knowledge of the animal, both tame and wild, than any European living, should place so low an estimate upon his mind. He declares that "its sagacity is of a very mediocre description," and also that "its reasoning faculties are far below those of the dog, and possibly other animals."

From this view, which I think is due to the fact that "familiarity breeds contempt," I differ very widely. My acquaintance with tame elephants has created in my mind a respect for their

intellectual qualities which I never could have acquired in any other way. A trained dog or horse is such a rarity, even among the thousands of their species, that it is considered a proper object to exhibit at a circus. A horse which will promptly back at the word of command, or a dog that will bark or stand on its hind legs when told to do so, is considered quite accomplished; but in India any well-trained elephant, at a word or touch from his driver, who sits astride his neck, will "hand up," "kneel," "speak" (trumpet), "salaam" (salute with his trunk), stop, back, lie down, pull down an obstructing branch, gather fodder and "hand up" to his attendant, turn or lift a log, or drag it by taking its drag-rope between its teeth. He will also protect his attendants, or attack a common enemy with fury. I think I am safe in asserting that there are in India to-day scores of captive elephants who are capable of performing all the services enumerated above; but of course there are many which are not so intelligent.

Contrast with this the performances of our most intelligent breed of dogs, the pointer. Even when young and trained under the most favorable circumstances, they are at best but capable of being taught only a few things, as to "go on," to "charge," to go in a given direction, and retrieve. The extreme difficulty of teaching a dog anything after he has passed his puppyhood is so universally acknowledged as to have given rise to the familiar proverb, "It is hard to teach an old dog new tricks." What a strong contrast is seen in the wild "koomeriah" elephant, caught when he was about sixty years old (by Mr. Sanderson), who "was easily managed a few days after his capture." Of all animals in the world what other would have so quickly learned that mind is superior to matter, that man is master of the dumb brute, or would have succumbed so gracefully to the inevitable?

Intelligence of the Orang.—We will not say anything about the place the orang has in the long chain of evolution; but while abstract argument leads hither and thither, according as this or that writer is most ably gifted for the same, there is still one argument or influence to which every true naturalist is amenable and which no one will ignore who has studied from nature any group of typical forms. Let such an one (if, indeed, one exists to-day), who is prejudiced against the Darwinian views, go to Borneo. Let him there watch from day to day this strangely human form in all its various phases of existence. Let him see the orang climb, walk, build its nest, eat, drink and fight like a human rough. Let him see the female suckle her young and carry it astride her hip precisely as do the coolie women of Hindostan. Let him witness their human-like emotions of affection, satisfaction, pain and rage—let him see all this, and then he may feel how much more potent has been this lesson than all he has read in pages of abstract ratiocination.—*Hornaday's Two Years in the Jungle.*

## ANTHROPOLOGY.[1]

DR. RAU'S PREHISTORIC FISHING.—No. 509 of the Smithsonian Contributions to Knowledge, is entitled "Prehistoric Fishing in Europe and North America." By Charles Rau. Washington: Published by the Smithsonian Institution. 342 p., 405 ills., 4to. This is an attempt at constructive anthropology. The author has sedulously examined archæological literature for accounts and illustrations of discoveries bearing on the fisherman's art. Placing these objects side by side with similar modern forms whose uses are known, the author has been able successfully to bring before us in his true attitudes the ancient artisans of the class under consideration. Access to the immense collections of the National Museum, and familiarity with the staff of the United States Fish Commission during many years, as well as the coöperation of archæologists at home and abroad, have strengthened Dr. Rau for his work and enabled him to prepare a monograph upon prehistoric fishing which will remain the standard authority upon that subject.

The volume is divided into two parts, that relating to Europe, 112 pages, and that relating to America, 224 pages. In the account of European fishery the chronological order is followed. Discarding the Tertiary, Dr. Rau discusses the implements of the drift, caves and rock-shelters, shell-deposits, lake-dwellings and bronze age which may have been associated with fishing. In the account of American fishing a different plan is pursued, each genus or species of apparatus related to fishing receiving attention in the following order: Fishing implements, utensils, boats and appurtenances, prehistoric structures connected with fishing, representations of fishes, aquatic mammals, etc., artificial shell-deposits. This portion closes with a large number of extracts from the old writers upon aboriginal fishing in North America, and an appendix on prehistoric fishing in South America.

There are many classific concepts according to which the anthropological objects in a museum may be arranged and their significance discussed, and each one of these is of great importance. Principal among them are race, nation, material, geographic distribution, chronology, evolution, structure and craft or function. These concepts are not antagonistic, but mutually supplementary, the only question in the curator's mind being which of them to place first, and in what order the others shall be placed. In the archæological department of the National Museum Dr. Rau places the concept *structure* at the head of the list. By all odds this is the best for archæological materials, because it not only enables the curator to have a sure place for every object, but it enables him or the student visitor to take up each craft exhaustively. There is no doubt that the immense

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

treasures under Dr. Rau's charge will enable him, now that the material is arranged, to give many more contributions as interesting as "Prehistoric Fishing."

A NEW CRANIAL RACE CHARACTER.—Dr. Lissauer, of Dantzig, has recently published an important work with the following title: Untersuchungen über die sagittale Krümmung des Schädels bei den Anthropoiden und den verschiedenen Menschenrassen. Von Dr. Lissauer in Dantzig. Mit sieben lithographirten Tafeln. Separat-Abdruck aus dem "Archiv für Anthropologie." XV Band, Supplement. Braunschweig, 1885. pp. 112.

The author of this treatise introduces his subject with these words: "By sawing a skull through the sagittal median plane, and drawing, as exactly as possible, the outer contour of the section thus obtained, we get the sagittal aspect of the skull, the *norma sagittalis*. It presents a very irregular curve." * * * "A careful study of this curve in the different skull-forms of anthropoids and man will therefore be the object of this treatise."

Although, for the purpose of definition, the author speaks of sawing the skulls, in practice he does not consider it necessary; but describes an ingenious apparatus by means of which the sagittal curve may be traced without injury to the skull. His promise of a "careful study" has been well fulfilled. Every point of importance seems to have been thoroughly considered and clearly set forth. Dr. Lissauer has been obliged to invent a number of new terms, and as these will, no doubt, take a permanent place in the nomenclature of craniometry, it is fortunate that they are terms well devised.—*W. Matthews.*

ETHNOLOGY OF ANCIENT ITALY.—The ethnology and history of the populations of ancient Italy present problems of high interest, but these are just as perplexing through their intricacy as they are insolvable through the remoteness of the periods. Recent archæological finds have added new problems, but on the other hand have helped in clearing up doubtful points. Dr. Fligier, in his "Urzeit von Hellas und Italien,"[1] has given very strong reasons for supposing that the Japygians and Ausonians, as well as other aborigines of Middle Italy who passed for Pelasgians among the Romans, were, in fact, of the same race and stock as the Illyrians of antiquity and of the Pelasgians of Greece, and that a remnant of these and their language has survived up to our period in the Albanians or Shkipetars. Every year presents us with new researches on the subject. Some of these mainly rest upon the testimony of the ancient authors, which are often conflicting and in many cases legendary and absurd, while others try to combine all the dates afforded by archæology, history, ethnology and linguistic science, to reach trustworthy results. This was the method followed by

[1] Archiv für Anthropologie, Band 13, Heft 4 (Braunschweig, 1881).

Dr. Fligier and by Baron Charles von Czœrnig, a high functionary of the Austrian government, who in a recent octavo volume of 311 pages has published his researches upon Upper Italian nations of ancient, mediæval and modern times. The people of the Euganeans, whose name is preserved in the territorial names of *Valsugana* (Vallis Euganea) and Palugana, the author considers to have been Ræto-Etruskans, though he treats of them separately. In the momentous question, whether the Etruskans spoke an Aryan or a non-Aryan language, he prefers to await developments than to give a definite opinion, but considers the Ræti as a people originally identical with the Etruskans. They remained in the Alpine mountains, while the latter moved south into the plains of the Po river and settled there after subjugating the aboriginal people called Umbri. The Venetians, or Henetoi, a comparatively pure-blooded race, seem to have been Thracians, and the ancient authors almost unanimously proclaim their descent from Paphlagonia. The Celtic origin of some local names is distinctly traceable, on the western part of the Lombardic plain especially (p. 219). The sketchy biographies given of mediæval princes in Lombardy are very spicy bits of reading, and give us very graphic ideas of the arbitrary and cruel despotism in those dark ages. A short aperçu of the country's condition during the Napoleonic and recent period, mainly based on statistics, concludes the volume.—*Alb. S. Gatschet.*

Geographical Names in Mexico.—Antonio Penafeil, superintendent of the department of statistics in the Mexican Republic, has published in Mexico an alphabetical catalogue of the places in Mexico whose names are related to the Nahuatl language. In the catalogue of municipalities are many names so mutilated in orthography that it is difficult to recognize their origin and signification. Signor Penafeil has undertaken to reconstruct this nomenclature, forming an alphabetic index of American names of places existing in the latest part of the empire of Montezuma II, drawing his information from historic documents and from the hieroglyphic writings of the Nahuas, which are rightly considered to be the purest fountain of the ancient history of the Mexicans. Each word in this quarto volume of 220 pages is accompanied with the hieroglyphic symbol of the place, and with its equivalent in old and in modern Mexico.

The Kansas City Review.—This standard periodical, whose death was prematurely announced in the Naturalist, has put on a new dress and appeared in its ninth volume as number one of a new series. The editorial chiefs will be Dr. Theo. S. Case and Mr. Warren Watson. It is with sincere pleasure that we recall our obituary and give notice of the reörganization of the *Review*, with a shorter title and a brighter face.

## MICROSCOPY.[1]

THE ALIMENTARY CANAL OF THE CRUSTACEA —1. *Hardening.*—For the river cray fish, Frenzel[2] recommends Kleinenberg's picro-sulphuric acid diluted with only two times its volume of water. The preparation is left fifteen minutes in the fluid, then treated with the usual grades of alcohol. Osmic acid and the various chromic solutions proved worthless. Perenyi's fluid caused a slight swelling, but was of some service in the study of the liver and the nuclei of the middle gut. Corrosive sublimate (saturated aqueous solution) proved an excellent means of isolating the epithelium of the middle gut in the lobster. In preparations hardened in this fluid the epithelium becomes loosened from the wall of the canal, so that it can be stripped off in sheets and prepared for surface examination.

2. *Imbedding.*—Paraffine is preferred to celloidin. Precaution should always be taken to prevent the formation of large crystals, which not only render the paraffine brittle, but also injure the finer structure of the preparation, by immersing it in cold water and cutting soon afterward. If the paraffine block is allowed to stand for weeks crystallization sets in.

3. *Staining.*—The sections are fixed on the slide with chrome mucilage, then stained with alum carmine, alcohol carmine (Grenacher), aqueous hæmatoxylin (Böhmer) and safranin. For the epithelium of the middle gut a double stain with acid carmine and hæmatoxylin offers some advantages.

FRENZEL'S CHROME MUCILAGE AS A FIXATIVE.[3]—Make a thin solution of gum arabic in water and add to this an aqueous solution of chrome alum. An excess of the latter does no harm. A little glycerine is added to the mixture to prevent it from drying too rapidly when painted on the slide.

After painting the slide with a small brush the sections are placed in order and the slide left for a few minutes (not over fifteen minutes) in the oven of a water-bath kept at 30–45° C. The gum is thus rendered insoluble. The paraffine is next removed in the ordinary way and the sections stained according to desire. Fuchsin and safranin are the only analine dyes which cannot be used, as they stain the film of gum deeply and thus injure the preparation.

THE RETRACTILE TENTACLES OF THE PULMONATA.—The retraction of the eye-bearing tentacles of a land snail in the process of hardening may be prevented in the manner described by Flemming.[4] These organs, as is well known, are hollow cylinders,

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.

[2] Arch. f. mik. Anat, XXV, p. 141–143, July, 1885.

[3] Arch. f. mik. Anat., XXV, p. 52, April, 1885.

[4] Arch. f. mik. Anat., 1870, VI, p. 440; Zeitschr. f. wiss. Zool., 1872, XXII, p. 366.

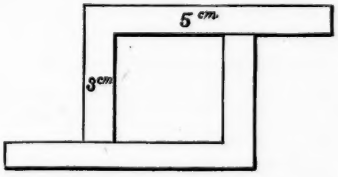
which can be rolled in like the finger of a glove by the action of a retractor muscle. The eversion is effected by forcing blood from the body-cavity into the lumen of the tentacle. If, when the tentacle is fully extended, a thread be quickly tied around its base so as to prevent the escape of the blood, the infolding process cannot take place, and the hardening fluid may then be safely applied. Flemming recommends treatment with bichromate of potassium (4 p. c.). This method enables one to obtain sections of the eye in the extended condition of the tentacle.

Imbedding in Paraffine.—*Clarifying media.*—Cedar-wood oil is recommended by Lee[1] as a clarifying medium on various grounds, the more important of which are the following:

1. It clarifies as rapidly as clove oil.
2. It does not render the object brittle or excessively hard.
3. It is a much better solvent of paraffine than clove oil; and hence only a short paraffine bath is required.
4. The penetration of the paraffine is not only more rapid, but also more thorough.

Holl[2] recommends toluol, which he finds can be used to greater advantage than chloroform, especially with large objects. The largest objects should be left one day in toluol, and one day in the paraffine bath; small objects require correspondingly shorter times.

*Imbedding Box.*—A convenient box, introduced by Dimmock, may be made of two pieces of type metal (or better of brass). As will be seen from the accompanying diagram, each piece of




metal has the form of a carpenter's square. A convenient size will be found in pieces measuring $5^{cm}$ (long arm) by $3^{cm}$ (short arm) and $7^{mm}$ high. With such pieces a box may be constructed at any moment by simply placing them together on a plate of glass which has previously been wet with glycerine, and gently warmed. The area of the box will evidently vary according to the position given to the pieces, but the height can be varied only by using different sets of pieces.

It is well to imbed in a thin layer of paraffine, so that the object, after cooling, may be cut out in small cubical or pyramidal

[1] Zool. Anz., No. 205, p. 563, Oct., 1885.
[2] Zool. Anz., No. 192, p. 223, April, 1885.

blocks, which may be easily fixed, for cutting, to a larger block of hard paraffine, or better, to a block of wood saturated with paraffine.

ORIENTATION WITH SMALL OBJECTS.—Orientation becomes difficult only with objects so small that their position can be controlled only by the aid of a microscope. Spherical objects, less than one millimeter in diameter, *e. g.*, many ova and embryos, are the most difficult to manage. Such objects may usually be successfully oriented in the following manner:

1. Prepare the box; for this it will be necessary to use the two triangular pieces of metal, a rectangular glass plate (2 in. x 2½ in.). The plate should be cleaned and then smeared with glycerine, and the pieces of metal so adjusted, that the arms are parallel with the edges of the plate.

2. Having warmed the box over a spirit lamp, lift the object from the basin of paraffine by the aid of a *small, flat, thin* spatula (first starting it from the bottom by shaking the paraffine a little), and allow it to *flow* with the paraffine carried on the spatula into the box.

3. Then fill the box (5–6$^{mm}$ deep) with the melted paraffine, and warm it a little over a spirit lamp, just enough to keep *all* of the paraffine in a liquid condition for a few moments. Now place the box on the warm table of a dissecting microscope, and by the aid of a hot needle proceed to place the object in the desired position. As the object is illuminated from below, it can be easily seen, turned over, and moved about at pleasure. If the paraffine freezes before orientation is effected, it should be melted again as before, and the needle must be kept hot by repeatedly holding it in the flame of the lamp.

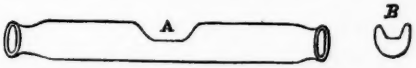
The difficulty of finding very small objects in a basin of paraffine will be very much lessened by keeping the paraffine free from dust, and the bottom of the basin (tin) scoured bright. A piece of emery cloth serves for polishing.

The necessity of re-warming the box of paraffine, which often arises in the above method, may be removed by using a hot bath on the table of the microscope. This bath should be a box of convenient size (not over 2$^{cm}$ high), with top and bottom of glass, with an opening at one end for filling with hot water, and another at the opposite end provided with a rubber tube and clamp, for drawing off the water as soon as the object has been arranged.

PREVENTION OF BUBBLES.—After the imbedding process has been carried thus far, there is still another danger to be carefully guarded against. If the box is left to cool slowly in the air, bubbles are very likely to appear in the paraffine, which will prove a serious obstacle in cutting. Profiting by Caldwell's suggestion, to cool the box in water, one may avoid all such inconveniences. As soon as the paraffine cools around the object, so

that its position is secured, the box should be held in a vessel o cold water, first at the surface (until the paraffine has set), then fully submerged. In this way the paraffine is quickly cooled sufficiently for removal from the box, which may then be used for imbedding a second object. A dozen objects may be thus imbedded in a very short time. If the box is plunged below the surface of the water, before the paraffine has become rigid, holes will arise in the mass and fill with water.

Box and Warm Bath Combined.—Selenka[1] has recently described a simple apparatus for imbedding small objects in a definite position. It is made by taking a thin glass tube, and heating one side at the middle until it becomes soft enough to bend easily. Then the mouth is applied to one end while stopping the other with the finger, and the air sucked out, causing the softened portion to bend inward and thus forming a shallow trough, A. A section of the trough is shown in B. In order to make the bottom of the trough flat, it is only necessary to place in the tube, before




Selenka's Imbedding Box (reduced ½).

heating, a strip of glass, against which the infolding portion of the tube will flatten.

One end of the cylinder is joined by rubber tubing with a T-shaped tube, one arm of which connects with a somewhat elevated liter glass of cold water, and the other arm with the hot water of the water-bath. The connection with the water reservoirs is through rubber tubing, which can be closed by pinchcorks. The other end of the glass cylinder is also provided with a rubber tube through which the water flows into a vessel standing on the floor.

The cylinder is fastened (by string or clamp) to the table of a dissecting microscope, with the trough at the centre. The hot water is then turned on and allowed to flow slowly. The trough is next filled with melted paraffine by the aid of a hot pipette, and the object dropped in and oriented with a needle. As soon as the object is placed in the desired position, the cold water is turned on, which causes an immediate stiffening of the paraffine. The hot water is shut off, and after a few moments, the paraffine with the imbedded object can be removed from the trough. The trough should be washed with absolute alcohol before imbedding.

[1] Zool. Anz., No. 199, p. 419, July, 1885.

## SCIENTIFIC NEWS.

— Henry P. Bowditch, Francis A. Walker, William Minot, Jr., and Charles S. Minot, have signed a declaration of trust for the Elizabeth Thompson Science Fund. Mrs. Thompson has presented $25,000 in trust to these gentlemen "to be the means of ennobling and promoting investigation and the study of science for the sake of science and the benefit of mankind." This endowment is not for the benefit of any one department of science, but it is the intention of the trustees to give the preference to those investigations, *not already otherwise provided for*, which have for their object the advancement of human knowledge, or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance.

Applications for assistance from this fund should be accompanied by a full statement of the nature of the investigation, of the conditions under which it is to be prosecuted, and of the manner in which the appropriation asked for is to be expended. The applications should be forwarded to the secretary of the Board of Trustees, Dr. C. S. Minot, 25 Mt. Vernon street, Boston, Mass., U. S. A.

The first grant will be made early in January, 1886.

— Dr. William Benjamin Carpenter, LL.D., F.R.S., an eminent English physiologist, died in London, Nov. 11. He published an important work entitled, Principles of General and Comparative Physiology. His reputation was widely extended by an excellent work called, Principles of Human Physiology. For many years he edited the *British and Foreign Medico-Chirurgical Review*. He will also be remembered for his work on the physics of the ocean, on Foraminifera and crinoids, as well as for his treatise on the microscope. Dr. Carpenter died from the effects of terrible burns caused by the upsetting of a lamp while he was taking a vapor bath for rheumatism.

— A telegram from Memphis says that "millions of squirrels are emigrating from the Mississippi side over to the Arkansas shore at a point commencing about five miles below Memphis and extending down for twenty miles. They are swimming the Mississippi river and evidently making for more elevated grounds in Arkansas. Thousands are being killed by farmers, who, by reason of their great numbers, use sticks instead of guns. A similar emigration of squirrels occurred in 1872."

— We willingly correct an error into which we fell in our last number. Besides the Comision Cientifica of Mexico, there is a Comision Geographico-Exploradora, of which the director is Señor Augustin Diaz. Professor Ferrari-Perez is the chief of the Section de Historia Natural of the latter. This gentleman is at present in the United States engaged in identifying the natural

products of his country as represented in our museums and libraries.

— Thomas Davidson, the English scientist, is dead, at the age of 68. His researches were principally connected with geology and palæontology. His large work on British Fossil Brachiopoda, in five quarto volumes, will be, when published, one of the most complete palæontological monographs ever published. He has also published eighty scientific papers. His collection was bequeathed to the British Museum.

— The board of regents of Kansas State University, at a recent meeting unanimously resolved to name the new museum ldguinib in process of erection, "Snow Hall of Natural History." This is a deserved compliment to Professor F. H. Snow, whose connection with the institution has been one of the mainsprings of its success.

— The death of M. Charles Robin, the eminent histologist, is announced from Paris. He had been professor of histology at the Faculty of Medicine since 1832, and was in his 65th year. In 1871 he worked with Littré in founding the Society of Sociology, and by his death the Senate loses all but the last of its scientific men.

— The October number of the Johns Hopkins University Circular embraces a résumé of the work done in the Chesapeake Zoölogical Laboratory, under the direction of Professor Brooks, from May to September, 1885. It shows that much successful work was done during the season.

— At the meeting of the Linnean Society of New South Wales, for May 27, Dr. Lendenfeld announced the discovery of sensitive and ganglion nerve-cells in the horny sponges, similar to those which he had observed as occurring in calcareous sponges, but much larger.

— Dr. William Wood, of East Windsor Hill, Conn., died August 9, 63 years old. He was an excellent local ornithologist, several of his papers appearing in the early volumes of this magazine.

— The Annales des Sciences Naturelles, XIX, No. 1, contains discourses by Professors Quatrefages, Blanchard and Lacaze-Duthiers, pronounced at the funeral of Milne-Edwards.

— The *Kansas City Review* comes to us in a new dress and with additional interest in its contents. The labor of years devoted to it by Col. Case is evidently meeting its just reward.

— James Macfarlane, author of Geological Railway Guide and Geologists' Traveling Hand-Book, died October 12, at Towanda, Penna., aged 66.

— Dr. H. A. Atkins, of Locke, Mich., also a good local ornithologist, died May 19, aged 63.

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## PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BIOLOGICAL SOCIETY OF WASHINGTON, Oct. 31, 1885.—Communications: Col. Marshall McDonald, Fish-culture a necessity for the maintenance of the shad fishery; Mr. Wm. H. Dall, Deep-sea mollusks and the laws illustrated in their development; Mr. Richard Rathbun, Remarks on the Woods Holl station of the U. S. Fish Commission; Mr. Romyn Hitchcock, Notes on the ed snow, with exhibition of specimens.

NEW YORK ACADEMY OF SCIENCES, Oct. 5, 1885.—The following papers were presented: On the agatized woods and the malachite, azurite, etc., from Arizona (illustrated with specimens of all, and with microscopical sections of the fossil woods); also, Some notes on the new meteorite that fell in Western Pennsylvania, by Mr. Geo. F. Kunz.

Oct. 19.—The following paper was presented: On a phosphorescent flagellate infusorian, probably a new species of Noctiluca, from the surf at Ocean Beach, N. J. (with an exhibition of the phosphorescence, and of preparations under the microscope), by Dr. Alexis A. Julien.

Nov. 2.—Dr. J. S. Newberry addressed the academy upon the recent Geological Congress at Berlin, its objects, its results and its men.

BOSTON SOCIETY OF NATURAL HISTORY, Oct. 7.—Dr. S. Kneeland described the family-life of the Norwegian Lapps, and the habits of the reindeer.

Oct. 21.—Dr. S. Kneeland exhibited models of two memorial gravestones of the iron age, from Central Sweden, bearing Runic inscriptions and other symbols.

Nov. 4.—Professor F. W. Putnam related the circumstances under which the skulls of a mastodon and of a man were found together at Worcester, Mass.; Mr. Wm. M. Davis spoke of the drift-formations in which the skulls were buried.

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